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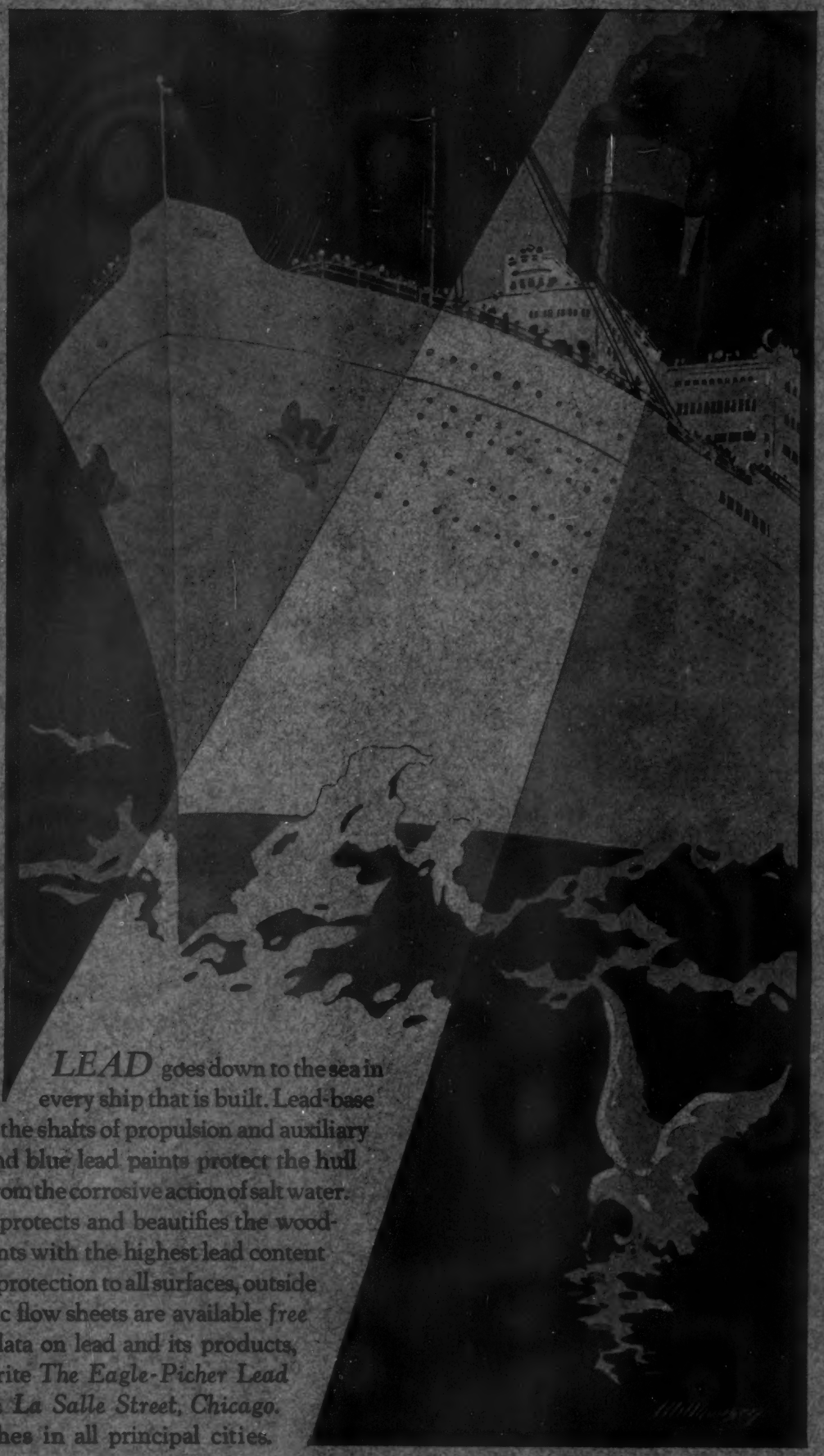

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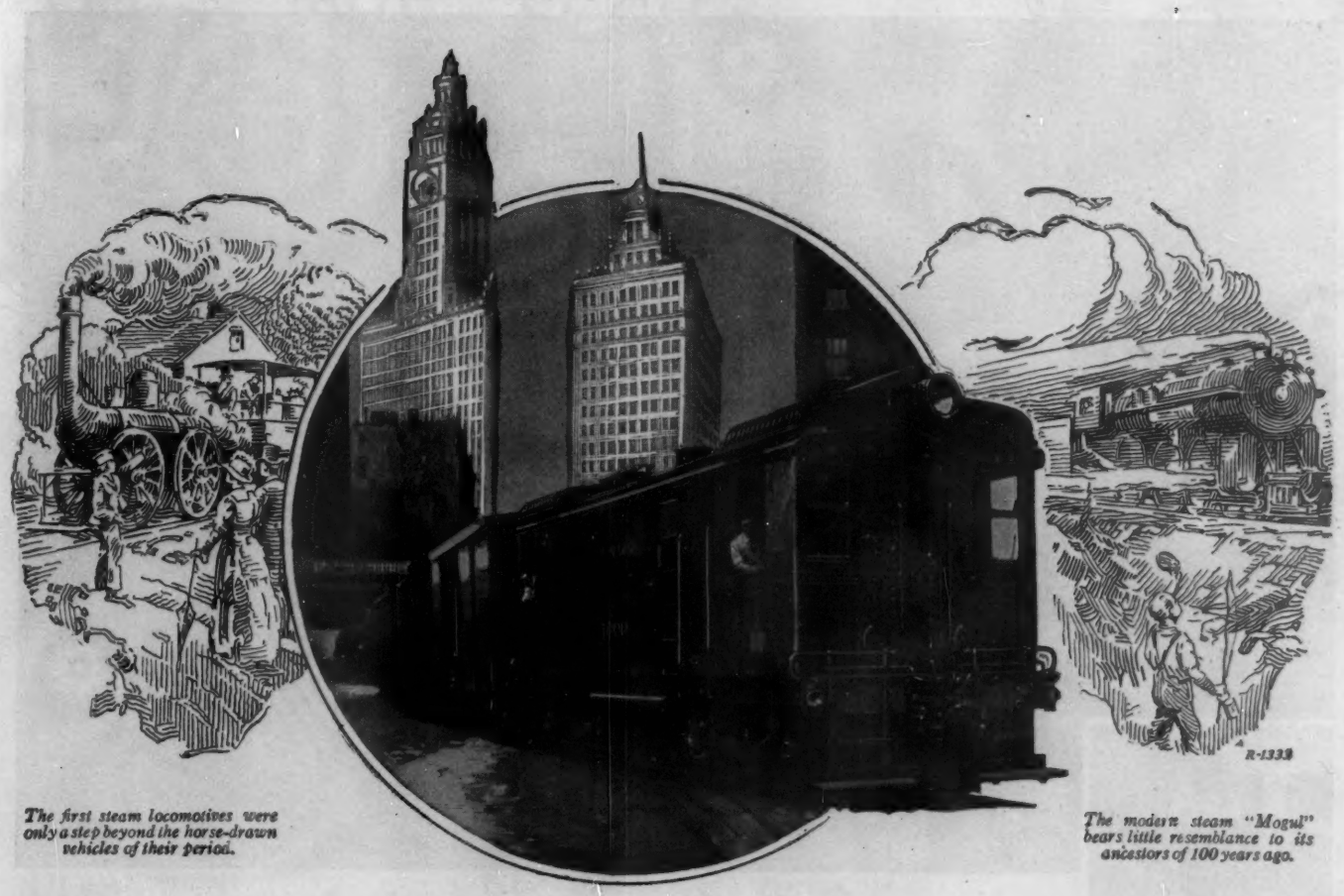

The first steam locomotives were only a step beyond the horse-drawn vehicles of their period.

The modern steam "Mogul" bears little resemblance to its ancestors of 100 years ago.

An Industrial Pace-Maker

THE last century has witnessed American transportation grow from a modest stripling into a full-fledged giant with more than his share of responsibilities. Regarded with skepticism a hundred years ago, this unpromising infant has gradually welded the country into an industrial unit that has no peer the world over. And he is only just beginning!

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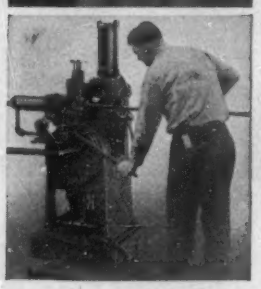

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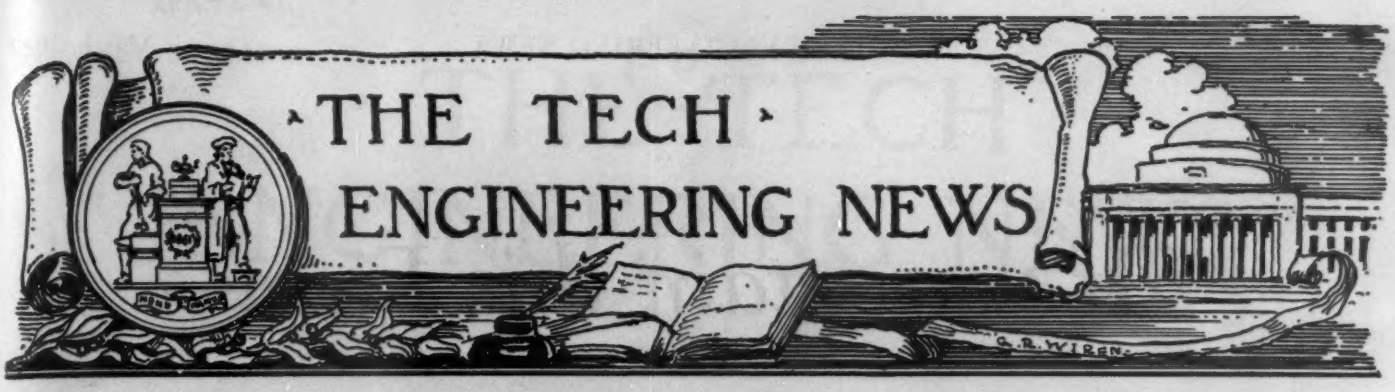

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THE TECH ENGINEERING NEWS

THE PROFESSIONAL JOURNAL OF THE UNDERGRADUATES OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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The Engineer in Politics

Trained engineers are required to administer the various departments of government

T. C. DESMOND, '09
President of T. C. Desmond, Inc., New York

IN an article published some years ago, I remarked that a good deal had been written and said in regard to the unfortunate fact that so few engineers ever occupy important administrative and executive positions in life as compared with men of other professions, lawyers for instance, many of whom secure such positions. The point of this article is to put forward again that engineers, both young and old, take more interest in politics and by so doing not only fulfill their plain duty and help the communities in which they live, but also supplement their technical experience with a broader understanding of men and affairs. There would be more engineers rightfully in prominent positions both in public and in private business life if more engineers had taken supplementary courses in the great graduate school of American politics. Very few engineers in general, and in particular, as I can testify from personal knowledge, very few graduates of the Massachusetts Institute of Technology, are active members of political party organizations. This is bad for the country, as no democracy can be conducted properly without political work from its citizens, and bad for the engineers themselves.

By "Engineers in Politics" we mean engineers active in city, state or national political-party organizations, that is, engineers who take the time necessary to study the political issues of the day, who familiarize themselves with the machinery of popular government, who belong to local political clubs, who attend political meetings and party conventions and strive continually in a practical way to make their beliefs effective as regards good candidates for office and good party programs of legislation. Engineers active in politics in this way will benefit greatly the communities in which they live and will themselves be benefited. Let us consider this personal side first.

Activity in politics and in general civic matters will benefit an engineer greatly because it will bring him into close and friendly relationships with other men of entirely different outlooks on life. It will give him a broader sympathy and understanding with men of other businesses and professions. It will strengthen his place in the community as a citizen and as a man and not merely as a technical machine. By greatly enlarging his personal acquaintance it will give him the opportunity of learning to be a quick and accurate judge of men, which is a qualification necessary for the man who would hold an important executive position.

Activity in politics and in community affairs, taking part in discussions at general meetings, etc., will help to teach the engineer how to express his ideas in terms that will be understood by other men. It will help to develop in him the power of forceful expression, the ability to persuade other men of the truth of what he says.

Activity in politics will also teach the engineer something he seldom, if ever, learns from his technical experience, that is, to judge shifting data. This point about shifting data is worthy of the strongest emphasis. Most engineers have learned to reason correctly from data which are fixed and determinate, as is usually the case in purely engineering problems; but few engineers ever get so that they can fulfill that qualification which is so often required and vitally important in high administrative positions, the ability to find quickly the approximate truth from a complex problem not capable of exact solution where the data are perhaps changing even while a conclusion is being reached. Experience in studying political problems and in making decisions in political matters will help to develop this qualification in the engineer. Such experience would help to qualify for the presidency of a great corporation many a man who is now just a good chief engineer.

Few good engineers ever get beyond the chief engineer stage. They remain in a state of mind where they would be almost lost in dealing with the indefinite problems continually coming before an administrative executive, problems in which only a few moments' time can be given to consideration before a decision must be made; problems which no slide-rule or math-

Editor's Note—The author of this article, Mr. Thomas C. Desmond, is a graduate of the Massachusetts Institute of Technology, Course I, 1909. Mr. Desmond is President of the T. C. Desmond & Co., Inc., Engineers and Contractors, of New York City and a former President of the Newburgh Shipyards, Inc. Mr. Desmond has also had a considerable experience in civic and political matters: he is a member of the New York Republican County Committee, President of the New York Young Republican Club and Chairman of the Committee on Public Affairs of the Union League Club of New York. He is Vice President of the M. I. T. Alumni Association for this year and President of the Technology Clubs Associated.

ematical tables can solve and in which a pretty complete knowledge of general affairs is helpful for a correct solution. Engineers would occupy more executive positions of prominence, instead of letting the lawyers have most of them, if like the lawyers they sought more experience in politics of the kind which helps to give the training prerequisite to the proper filling of such positions.

In general, it will be a great benefit to the community in which the engineer lives to have him give part of his time to political work. It could easily be shown that most of the failures of our democracy, and we are far from having in America a very successful democracy, are due to the fact that a great many of our best qualified citizens do not attend properly to their political duties. On this ground alone it would be well to have engineers active in politics. But above this general reason there are several special reasons why the influence of engineers in politics would produce much good.

In the first place, the average engineer would bring him into politics, regardless of everything else, a straight, clean character. In spite of the many faults and deficiencies of engineers as a class there is little question that association with engineering work does tend to bring out all there is of truth and honesty in a man. Just trying to design and build things strong and straight is what an engineer does all the time, and a little more of that spirit and influence in American politics would answer many of our governmental problems. There has been too much of the worst kind of the second-rate lawyer spirit of equivocation and specious pleading in American politics and too little of the straightforward, constructive, honest, unselfish work done by men to whom that kind of work is a matter of course.

While acknowledging the patriotism, the devotion and the vision of many of the lawyers who have borne the burden of public service and political work in the past when men of other professions and businesses, including engineers, were shirking this burden, one cannot help but think that it would be a very good thing for the country if the places of many lawyers now in public life were taken by engineers. The lawyer has essentially an analytical mind and is primarily a critic, while the engineer is essentially a builder and is accustomed to driving through constructive programs, of planning things definitely and then completing them.

The special familiarity of engineers with many of the functions of a government is another reason why their influence in politics would be for the good of the community. City governments in particular have largely to do with engineering matters, such as the building and care of streets and pavements, sewers, water and lighting systems, etc. State and national governments also are largely concerned with the administration of engineering matters.

Our first American President, and one of the greatest characters the world has so far produced, George Washington, was trained as an engineer in his youth, and the example which he gave of constructive public service should be an inspiration to all other engineers.

There are many reasons why, in working on modern national problems, the help of engineers will be especially effective. This is largely an engineering age and engineers are responsible for much of the complexity of modern life. The development of applied science, with its tremendous effects on the economics of production, has changed greatly the relations of people to each other and the relation of the government to the people .

With no sacrifice of individual liberty, except where that individual liberty menaces the public welfare, more attention should be paid to the health of our people. In this work our sanitary engineers can be of the greatest assistance. The marked lowering of the death rate that has come in many cities from proper engineering supervision of matters of water supply and sewage disposal is known to all. The beneficial results which follow proper engineering attention to matters of street cleaning, garbage disposal, etc., are also very important. Engineering studies of the housing conditions of our people, particularly in the tenement districts of the large cities, may also be productive of much good. We are a prodigal, reckless nation, reckless of the health and lives of our people even while we have the scientific means at hand to preserve them. Needless deaths and needless sickness certainly make for national inefficiency, and engineers can show very well the advantages of helping to safeguard the public health.

Is a democratic form of government really unsuited to human nature as it now exists? Is a strongly centralized, autocratic government really a better form of government under which to live? To every American who still cherishes the democratic ideals for which his forefathers fought the answer must be "No" to both of these questions. But at the same time the obligation rests with the man who answers "No" to see to it that he does his part toward making our ideals of democracy practical. American engineers have always answered the call to national duty in times of war, and, if they can be brought to realize fully the need, they will answer the quieter calls to duty in times of peace.

The public has been made familiar of recent years with the extraordinary results of increase in efficiency of production which have attended the introduction by engineers of the principles of scientific management into many industries. In a few cases where cities have appointed city managers, engineers have been given these positions, and have done well in carrying out some of the principles of scientific management in the administration of city affairs. This is of course a good thing and it is a tribute to engineers that they should be hired as capable city administrators. But if engineers are to be most effective for good government, they should be not merely governmental employees, but the men of power behind the government as well, the leaders of public opinion, and this implies that they should be active in city, state, and national politics.

The interest of engineers in politics should not be merely a temporary thing, kept up during some particular campaign. It should be a lifelong interest, kept up as a matter of duty. By activity in politics, and particularly activity in political party organizations, engineers will be able to make their beliefs effective in a powerful way. They will be able to affect the currents of public opinion at the source. With more good men active in party organizations, other good men will consent to stand as candidates for public office. We shall get back more of that fine spirit in American life which deems it a high honor to serve the State. And a popular respect for government, brought about by the kind of democratic government that can be respected, will do much to help America.

Will engineers forever be content to remain technical subordinates and let others manage their government? This is a time after a great world upheaval. New problems, many of them resulting from the World War are constantly coming up for solution by our political leaders and the electorate. During this vital period of national adjustment, when democracy as never before is on trial, shall engineers keep giving their best thought to their blueprints, with never any visions beyond such things as the strength of materials? Let it rather be said that engineers who live in this great democracy will fulfill their duty as American citizens by taking an ac-

(Continued on page 92)

The Relation of Engineering to Public Utility

Description of some of the engineering problems in the field of public utilities

C. L. Edgar
President, Edison Electric Illuminating Co., Boston

WHILE the Public Utility business requires the highest grade of financial supervision and skilled business management, its operation is based on engineering practice and its success as an efficient business proposition depends on the engineering skill exerted in its behalf and the solving of its engineering problems.

In dealing with this subject I shall inject a local flavor into the discussion by describing briefly the growth of the Boston Edison Company looked at from an engineering standpoint, and describe some of the problems that have been put up to the engineers of the Company from time to time and how they have attempted to solve them. Most of the solutions have been successful, while some may have been the opposite.

As a young engineer located in New York, I was sent over to Boston in 1886 to make an inspection of the first station of this Company. It was located in a stable in the rear of what is now the main office building of the Boston Edison Company. I arrived in Boston during a heavy snowstorm, and found my way up through the crooked, narrow alley to the boiler room door. Snow which was coming down through holes in the roof, had already covered the tops of the boilers, and had formed a layer of slush on the fireroom floor about two inches deep. The little power plant itself, protected from the storm, was crude in the extreme. The whole station was a dilapidated spectacle indeed, and it would not be worth remembering or referring to if it were not for the fact that it was the beginning of the engineering work of the Company.

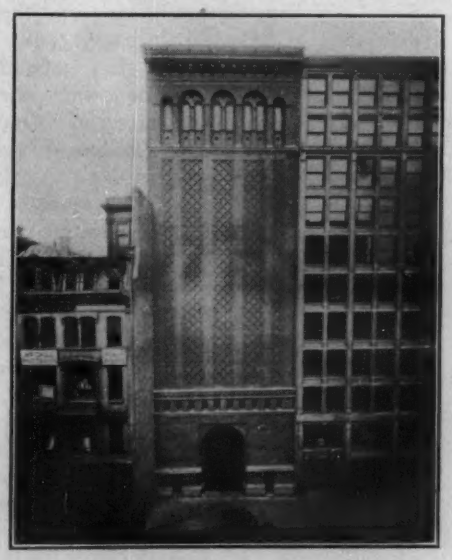
A few months later the adjoining property was purchased and there was installed therein what was at that time a model station. In the light of today it is almost impossible to realize that even that station, modern in 1886, had any elements in it which were a distinct advance in the industry, and yet such is the case.

High speed, single cylinder engines, directly connected by a belt to electric generators had been in use for a comparatively few years, but the plants in which there was more than a single installation were rather rare, and the problem of operating two or more generators in parallel turned out to be very largely a question of the engine governors. There was a tendency for the engines to race and the load to shift from one generator to the other in a very uncertain manner. As I look back on this condition from the standpoint of today, it seems to me that this was the real problem before the central station engineers of that day.

This article is an abstract of the Aldred Lecture presented to the seniors of the Massachusetts Institute of Technology by Mr. C. L. Edgar. It was especially prepared in this form by the author who is exceptionally well qualified to write on this subject. Mr. Edgar, as president of the Boston Edison Co., has had an opportunity to make a careful study of the various phases of the public utility field and it is our belief that his article will be of interest to our readers.

We installed fifteen of these engines in this new station, connected to thirty generators, and they were finally made to work very satisfactorily in multiple.

We had an experience which reflects very critically upon the engineering knowledge we possessed at that time. This station had been operating less than six months when it was entirely crippled by a fire originating in one of the feeder regulators and spreading to the walls and ceiling of the dynamo room. I am personally, perhaps, more to blame for the condition which caused this fire than any other one man.



AN EXAMPLE OF THE MODERN SUBSTATION

Note that the building is made windowless to reduce fire hazard.

During the two or three years previous to my coming to Boston, I had been installing small central stations in half dozen or more of the cities in Eastern Pennsylvania. I had very carefully lined the walls and ceiling with hard wood, beautifully varnished, and erected on the walls a series of bus bars made of round copper bent into all sorts of shapes and clamped to the wall by ordinary hard wood cleats. The feeder regulators, which were furnished by the manufacturers in ventilated wooden crates were carefully hidden behind this hard wood veneering so as to create a handsome looking interior.

Although I suppose we knew that electricity produced heat, none of us had had any practical experience in having this fact brought home to us in a convincing manner. I have often wondered since why these various stations did not burn down almost before I was able to leave town.

Having established this practice in Pennsylvania, I repeated it in the first station in Boston. The inevitable happened, the resistance coils became red hot, and fire resulted.

This shows how little we really knew of the force which we were attempting to harness way back in the 80's, and indicates the kind of problems which were put up to the engineers of the Company at that time.

This station was, of course, run noncondensing. As the amount of water necessary for condensing purposes weighs about six hundred times as much as the coal burned under the boiler, the practice of condensing had to be entirely eliminated. This station supplied three-wire, direct current in an area of only one-half of a mile radius. It started in with an overhead system carried on the roofs of the neighboring buildings, and many and varied were the engineering problems of getting from one roof to another and erecting on these various roofs structures for the support of the wire which would not break down the roof. A few wires were immediately put underground, and I have very distinct recollections, even at this late day, of walking down Tremont Street, near the side door of what is now the

Hotel Touraine, and seeing the so-called insulating compound oozing up between the cobblestones.

The question of grounding the neutral wire, the question of installing fuse blocks in each of the manholes, not only upon the feeder which ran from the station to the manhole, but upon the mains running between manholes,—all these came up and were settled in these early days by the engineers connected with our industry.

It was only a year or two after the starting of the first station that a second station was installed in Hawkins Street near Haymarket Square, in the North End, and this one went through the same process of elimination of progress as did the first station. This station was, of course, also non-condensing.

It was in 1889 that we decided to install a third station, and we picked out land at the foot of Pearl Street on Atlantic Avenue.

Here we had an entirely different problem. We had plenty of salt water for condensing, and we decided to build a station very much larger than the other two combined. I had heard that some of the German companies had developed vertical engines with dynamos connected directly to the shafts of the engines, so I made a visit to Berlin, in 1890.

There I saw in actual operation vertical engines of considerable size directly connected to electric generators. On my return to this country, I got in touch with two or three manufacturers of Corliss engines and told them what kind of installation I was proposing to make and asked them for bids. I was turned down completely, —in fact, one engineer, the head of one of the largest Corliss manufactories of his time, went on record in writing that the idea was a crazy one and that his firm would not consider it for a moment.

Persevering, however, we finally interested the parent Company—that is, the General Electric Company, or its predecessor, and they designed and had built for them a number of vertical engines of 400 kilowatts each. A 200 kilowatt generator was connected to each end of the shaft and we purchased and installed three of these units. These were the first vertical engines in this country used for electric light and power purposes, and marked an epoch in central station construction.

While the first two stations had feeders running from the stations to the various manholes which distributed mains to the customers, there was no direct connection between the two stations themselves. If trouble occurred in one station, the customers

A UNIT OF THE SECOND LARGEST POWER STATION

One of the turbo-generators at the new Edgar station. This single unit supplies many hundred times more power than the entire power plant shown on the opposite page.

of that station immediately lost their service. In planning the waterside or third station, we not only installed exactly the same feeder and main system that I have described, but we also installed tie lines from the third to both the first and the second stations.

As years went on we were able to shut down either one or the other of the first two stations during the light hours of the day or during the summer months, and thus get a benefit from the greater efficiency which we obtained at the third station, due somewhat to the larger units, but principally to the condensing of the steam..

It was also at this time that we had an interesting development in the introduction of storage batteries. One small battery had been installed in one of the uptown stations in New York City, and we had heard stories of installations in Europe of large size which further excited our interest. I again visited Berlin in 1893, where I found that great advances had been made in storage battery manufacture, so I ordered a sizable installation to be installed here in Boston.

From that time to this we have installed batteries periodically, which in later years were made in America under both American and German patents.

In all these various battery installations, we had one conspicuous failure. As storage batteries will operate only on direct current, and as the Company does not supply such current outside the city of Boston proper, unfortunately all alternating current districts are compelled to get along without the added safety due to batteries.

In our alternating substation in Newton, we had installed some motor generators for supplying the Street Railway Company, that is, we turned high tension alternating current through a motor direct connected to a 500 volt direct current generator. We conceived the idea of making use of this 500 volt direct current and installing a storage battery of that voltage. This was not for the purpose of increasing the reliability of the street railway service, but was intended to work backward through the motor generator and add reliability to the local alternating service. This may sound rather complicated, and in fact it was decidedly so,—not so much in theory, but because of the various devices that had to be installed to get the stability of the direct current generator as the result of the installation of the storage battery, back through the motor and on to the local alternating circuits. We experimented with this for a number of years and finally gave it up as a more or less impossible task. This was, I think, the first and last experiment that has ever been tried to back up an alternating system with storage batteries.

It seemed in the beginning an almost impossible task to so insulate battery boxes that they could be kept free from grounds, owing to the sulphuric acid fumes which filled the room. These fumes not only destroyed the insulation, but attacked the steel work of the buildings, and in fact played havoc with all known methods of construction. The installation of storage batteries today is a very simple problem made simple, however, by the series of experiments that were carried on by us and by other central stations during a long period of years.

This method of making and distributing electricity in Boston continued until the later part of the 90's, with practically no change except the installation of larger machines. In the meantime, we had purchased control of a competing company which was using the alternating system and had purchased a large piece of property in South Boston which was the site of the shipyard where the old "Constitution" was built and launched. We began to hear stories of the development of the steam turbine and were so much impressed that we started the construction of a turbine station on this land lately acquired in South Boston. The turbine room was designed for the installation of 12—5000 kw. units. These turbines were being developed by the General Electric Company, and, as the result

of these experiments, we made our first installation in 1904.

In order to carry sea water to the base of our condensers located under the turbines, it was necessary to construct tunnels submerged a number of feet below ebb tide and a number of hundred feet in length. These have given us considerable trouble in years past by being blocked up by a growth of mussels. The problem of preventing the mussels from blocking up our tunnels, has been put up to the proper department of the Massachusetts Institute of Technology, and it is now making a study of this whole subject and has made us a report within the past few weeks of some rather definite suggestions as to what we should do.

From that time on our business grew by leaps and bounds, and today there is installed in that building, originally designed for 12—5,000 kw. machines, 11 machines ranging in size from 5000 at the one end to 30,000 at the other, a total of 186,000. When that station was built in 1904, I do not think that any of us by the wildest stretch of the imagination could have actually designed and started to build the station with the idea that we would ever get to 186,000 kilowatts, and yet this was all done inside the space of twenty years.

The erection of this station a number of miles distant from where the electricity was to be used again gave us an entirely different problem of distribution. In the beginning we installed underground cables to the three existing stations in Boston proper and transmitted electric current at 6,000 volts and then redistributed it from these existing stations in exactly the same manner as if it had been produced in the stations themselves.

We soon found that we could discontinue the steam plant in the first and second stations and depend entirely upon service from South Boston. The steam plant in the third, or Atlantic Avenue Station, was allowed to remain very largely for emergency use, and even yet we operate portions of it during certain hours of the winter for use in the immediate neighborhood.

As time went on we found that we needed other centres in Boston proper from which to distribute feeders, and we proceeded to erect at these centres what are commonly known as substations, the current being brought into them from South Boston, transformed into direct current by means of motor generators, and redistributed from that centre just the same as if they had their own steam plant. The most notable of these substations and the one which has attracted most attention from the casual observer is that erected on Chauncy Street. It is notable in that it has no windows or doors above the first floor. It is built in this way for fire protection, and is ventilated entirely through the roof. It has the disadvantage of cutting off the daylight from the men working within, but it has been in every way a success. We now have three of these windowless substations.

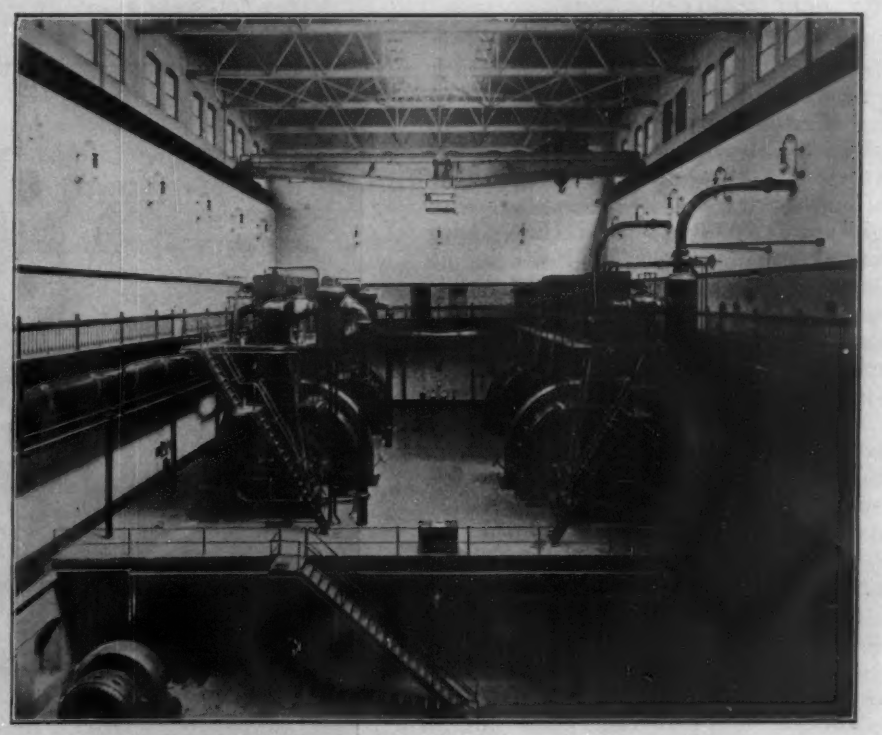
Soon after we started the erection of the South Boston Station, we began to acquire the electric properties in some of the neighboring cities and towns, and these were reached electrically in exactly the same way as those that were located in Boston proper. We naturally had to increase our transmission pressure as occasion required, but the current was sent from South Boston to Framingham, for example, where we redistributed it as it had been done by the owners of the original Framingham station. It soon developed that, like the two stations in Boston, there was no economic need of the steam plants in these stations, and they have all been dismantled and sold. We now cover 700 square miles of territory, supplying 40 municipalities and towns, and have nearly 200 substations scattered throughout this entire district.

Some five years ago, we appreciated the fact that the time was near at hand when our South Boston station would be filled with machinery, and we would have to look elsewhere for a site for a generating station. Distance from Boston was of comparatively little importance, but deep water for coal handling and plenty of water for condensing purposes were the prime requisites. We found such a location on the south side of the Weymouth Fore River, directly across from the Fore River Shipbuilding Works of the Bethlehem Steel Company. We succeeded in getting about sixty acres and in 1923 started to build the first section of what is called the Edgar Station, which is the last word in central station construction. The particular novelty is the question of steam pressure.

When the company was started in 1886, a hundred pounds per sq. inch was common practice. This was gradually increased when we erected our new stations until 300 or 400 lbs. was the practice when we were designing this new station. There were some arguments in favor of running up from 300 or 400 to 500 or 600 lbs. and using such pressure in the normal way. Some of our engineers, however, made the suggestion that we jump to 1200 lbs. and this practice was finally adopted.

A boiler of 1200 lbs. pressure was installed and this operates a turbine which takes steam at this pressure and discharges it at 375 lbs. into a header which is connected to the ordinary boilers and which supplies the ordinary turbines, these latter in turn taking

(Continued on page 90)



TWENTY-FIVE YEARS AGO; THE LAST WORD IN POWER STATIONS

The compound engines at the Atlantic Avenue Power Station that supplied Boston with electricity for many years.

Modern Central Stations

Illustrated by the new East River Station of the New York Edison Company

JAY BALSBAUGH, '24
Electrical Engineering Department,
Massachusetts Institute of Technology

THE purpose of this article is to give the engineering features incorporated in the design of modern electric power stations in general and some of the engineering features of the new East River Generating Station of The New York Edison Company in particular.

The East River Generating Station of The New York Edison Company is located on Fourteenth Street at the East River, in the Borough of Manhattan, New York. It was designed by Thomas E. Murray, Inc., in association with the Engineers of The New York Edison Company. Fig. 1 shows a view of the station at the present time.

The Station supplies 25 cycle current at 11,400 volts to the Edison System, and may also at a later date generate 60 cycle current at 13,800 volts. It also provides a means of tying in the Edison 25 cycle System with the United Electric Light and Power Company's and the Brooklyn Edison Company's 60 cycle Systems through large frequency changers.

In general it may be said from the point of view of ultimate economy that the most important engineering factors are the steam pressure, temperature and type of steam cycle utilized, the method of preheating the combustion air and feedwater and the operation of the auxiliaries. It is desirable to consider these factors in detail as to their influence on the station economy and the marginal improvements possible.

Relative to the steam pressure, an increase in pressure will give an increase in theoretical cycle efficiency. Thus the Rankine cycle efficiency with steam at 200 lbs. abs. pressure and a total temperature of 700°F exhausting to 29″ vacuum would be 33.8%, while with 1200 lb. abs. steam under the same terminal conditions gives 40.6%. However practically, this increase is impossible of attainment. With increasing steam pressure, since the total temperature is limited to around 700°F to 750°F, the amount of superheat is decreased. This results in considerably greater moisture through the lower stages of the turbine and therefore reduces the percentage of the heat energy theoretically available from being transformed into mechanical energy at the turbine shaft. That is the resultant economy will be affected by two efficiencies one of which increases with increase in steam pressure and the other decreases with increase in steam pressure. The result of this condition will be to give a maximum resultant efficiency at some steam pressure. With a Rankine or a regenerative Rankine cycle without reheating this resultant efficiency will be a maximum at approximately 400 lbs. abs. steam pressure.

For pressures higher than this value it will be desirable to resuperheat the steam after partial expansion in the turbine and consequently improve the turbine conversion efficiency. This resuperheating in general results in the best cycle efficiency when it is accomplished at approximately 0.3 of the initial steam pressure.

The regenerative feature is incorporated in practically all modern power stations. It is regenerative in the sense that steam is extracted from the turbine for the purpose of heating the feedwater before it is returned to the boiler or economizer from the condenser and therefore steam is used in the process of generating additional steam. The regenerative feature will give large savings in economy with relatively small capital expenditure.

The increase in economy resulting from incorporating the regenerative principle may be better appreciated when considered as follows: It is obvious, that in the electric power stations the most important losses are represented in the circulating water and in the flue gases. Any method of decreasing these losses will give a material decrease in station B.T.U. per KWH. Consequently the extraction of steam from the turbine at various stages and condensing this steam in an extraction heater where condensate is the circulating water, will transfer the latent heat in this extracted steam to the feedwater instead of allowing it to pass out in the circulating water. That is the extraction heaters are merely auxiliary condensers at higher heat levels than the main condenser so as to permit using the boiler feedwater for circulating water.

With steam at 400 lbs. abs. and a total temperature of 700°F the gain in theoretical cycle efficiency with regeneration carried to saturated steam conditions in the turbine, over that obtained by the Rankine cycle would be approximately 12%. This value would obtain with a heater located at every stage in the turbine. However one extraction heater properly located will give 1-3 to 1-2 of the full 12% gain and each additional heater approximately 1-2 of the gain of the preceding heater so that this marginal utility would tend to limit the number of heaters. In general this limitation will amount to 3 to 5 heat-

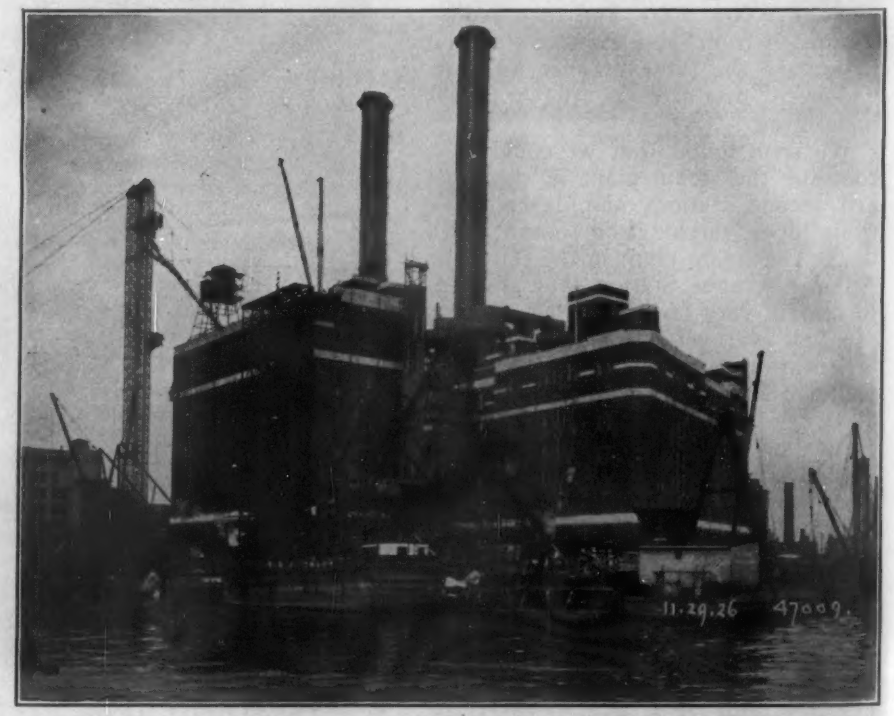


FIG. 1. TO KEEP BROADWAY "THE GREAT WHITE WAY"

ers depending primarily upon the steam conditions.

It was mentioned previously that the main losses in the electric power station are in the flue gases and the circulating water. The losses in the circulating water can be decreased by extracting all the steam from the turbine which can be economically utilized. The heat in flue gases carried up the stack can be decreased by decreasing the temperature at which they pass to the stack. This therefore introduces requirements for preheating the combustion air and the feedwater. With the boiler itself the minimum temperature at which flue gases can leave the boiler would be the temperature corresponding to the water in the boiler or approximately the temperature of the saturated steam. To reduce the gases to a lower temperature will require additional heating surface and transferring the heat to either the combustion air or the feedwater. That is the economizer or air preheater is merely additional boiler surface utilizing the counter flow principle and transferring heat at lower temperatures than is possible in the boiler itself. Since it is found expedient to preheat both the combustion air and the feedwater the question is to determine the relative advisability of preheating the feedwater by the flue gases or extracted steam or the combustion air by extracted steam or the flue gases.

In general the relative weights of combustion air and feedwater are approximately 2 to 1 respectively and the relative specific heats approximately 1-4 to 1 respectively.

Thus the heat which can be absorbed per degree rise will be twice as much for the feedwater as for the combustion air. Then if the extracted steam is used to preheat the feedwater, twice as much steam can be used as could be used by the combustion air for the same temperature ranges. This will leave the combustion air to be heated by the flue gases and the temperature ranges will be about equal since the weights of the gases are approximately equal. This represents the most desirable method theoretically, the main disadvantage being that the heat transfer rate from flue gas to combustion air will be relatively low resulting in bulky heaters.

Relative to regeneration or stage extraction there are other economies effected in addition to the theoretical gain. The rating of a turbine is limited to a considerable extent by the amount of steam which can pass the last stage wheel due to the congestion existing at this point. Consequently

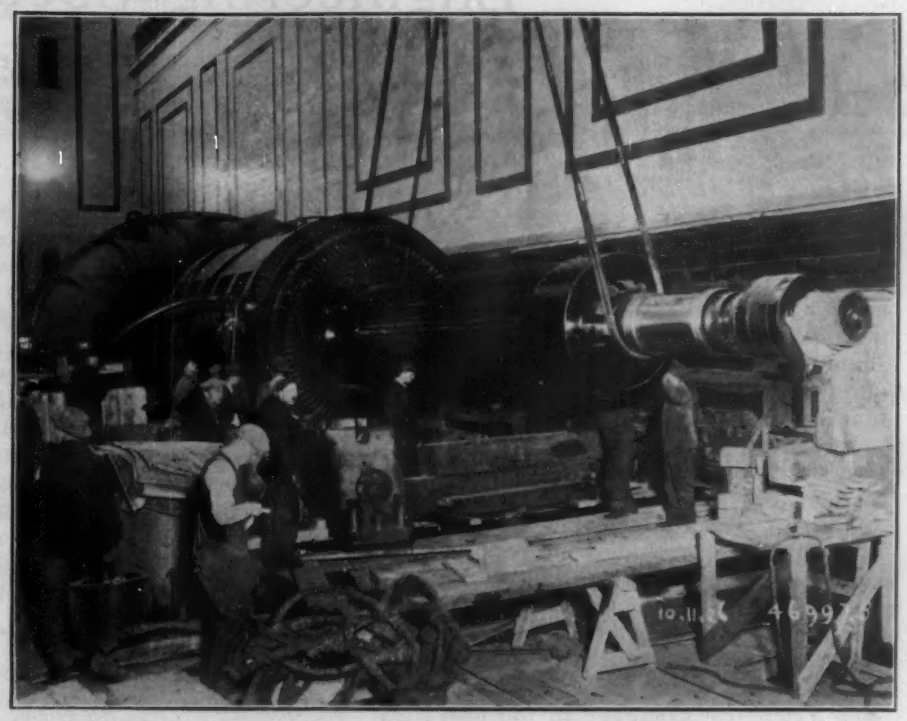


FIG. 2. THE GIANT ROTORS GOING INTO PLACE

any means of increasing the available heat energy per unit of exhaust steam will increase the rating of a given turbine casing. It may be noted that stage extraction accomplishes this in that work is transferred from the latter stages in the turbine to the initial stages. It may also be noted that increasing steam pressure, superheat, resuperheating will also increase the heat turnover per lb. consequently giving a greater capacity rating per unit of exhaust steam. There will also be indirect savings in the condenser and circulating pump capacity required per kw of turbine capacity.

The auxiliaries of the station may have a power requirement equal to 5% or more of the power of the main unit. Consequently the method of operation of the auxiliaries will effect the station economy. From the point of economy it would obviously be desirable to operate the auxiliaries by electric motors, these motors receiving their power from the main generator. Thus this would be a means of utilizing the water rate of the main unit for the auxiliary power requirements. However such a method would jeopardize the continuous operation of the important auxiliaries by the failures occurring on the main system. The auxiliaries which require a very reliable source of power in order to maintain continuous operation of the main unit under load are the boiler feed pump, circulating water pump, condensate pump, air pump, forced draft fan, induced draft fan and the stoker motors. In many of the recently designed stations this reliability is provided for by having an auxiliary generator on the same shaft as the main generator and driven by the main turbine and the important electrically operated auxiliaries being operated from this generator. This method will prevent system failures from being communicated to the electrical auxiliaries other than the influence these failures may have on the main turbine.

While this method represents advantages from the point of view of economy still it is relatively inflexible as regarding speed regulation. In the case of some of the auxiliaries it is necessary to provide for varying speed with changing load. In the case of circulating pump speed regulation with changing circulating water temperature will effect large economies. The use of individual steam turbines for the auxiliary drives permit more flexible speed control.

The heat balance and the method of the operation of the auxiliaries of the new East River Station of The New York Edison Company is given on page 84.

The condensate from the main condensers passes through the air ejector condenser and after cooler, and then successively through four closed heaters. The first is supplied with steam extracted from the 18th stage of the turbine; the second is supplied with steam from the auxiliary exhaust

(Continued on page 84)

Engineering Societies

Activities of the undergraduate professional societies of the Massachusetts Institute of Technology

ELECTRICAL ENGINEERING SOCIETY

On February 16, the members of the M. I. T. Branch of the A.I.E.E., made a trip thru the "L" Street station of the Boston Edison Electric Illuminating Company. They not only inspected the boiler house, turbine hall, and switch house, but were given an opportunity to go thru the load despatching room, a part of the station to which visitors are rarely admitted. The equipment seen was of great variety, ranging from reciprocating engines, vertical turbines, and several D. C. Gramme ring-wound generators to a modern 30,000 kw. turbo-alternator. A trip is contemplated to one of the exchanges of the Bell Telephone Company in the near future.

Much interest is being given to the A.I.E.E. Student Convention which is to be held in conjunction with the meeting of the First District of the A.I.E.E. at Pittsfield, Mass., in May. The morning session of the third day of the regular convention will be devoted entirely to the presentation of student papers and it is expected that Technology will be well represented upon this program. Any student of the Institute is entitled to submit a paper on a subject of interest to electrical engineers and it is hoped that many will avail themselves of the opportunity.

C. Bery '27.

SOCIETY OF AUTOMOTIVE ENGINEERS AT M. I. T.

Since Haynes constructed his first American gasoline carriage some thirty years ago, the automotive industry has grown faster than one would have believed possible even at the turn of the century. Today it is the largest commercial interest, bringing together raw and finished products from nearly all of our manufacturing concerns as well as requiring research and development in all sciences to produce our modern business and pleasure cars. Several of the manufacturers can number their daily output in thousands of vehicles while those in use consume thousands of gallons of gasoline a day—thus showing the enormous scale of the industry.

So it is only natural that there has grown up a Society of those men who are interested in automotive production in all its phases. The Society of Automotive Engineers has become one of America's most active organizations, having frequent meetings throughout the country to discuss the problems of the day in order to properly solve them.

The M. I. T. Student Branch was formed with the same idea in view. It is not only for those who intend to design our future internal combustion engines but for those who are interested in maintenance, metallurgy, electricity, electro-chemistry, fuel and production problems. Our aim is to provide interesting and instructive smokers and trips. Members of all courses will find an interest in the Society with this wide range of up-to-the-minute topics for discussion. Membership is open to all registered students at Technology. After paying his dues as an enrolled student to the parent Society, he receives the S.A.E. Journal for a year, has the privilege of attending all their meetings and can use the employment service. Upon being accepted, he is eligible to join the Student Branch and share in the activities. Here he is given the chance to become acquainted with the prominent men in the industry and to see the actual processes of manufacture.

At the first meeting, there were about a hundred and twenty-five present to hear Dr. S. A. Moss of the General Electric Co. of Lynn speak on "Superchargers." His talk was illustrated with many lantern slides and the complete airplane supercharger that he brought with him proved an interesting exhibit. The entire field of supercharging was covered from the first attempts on large gas engines to the modern practice for automobiles, airplanes and Diesel engines. Through the courtesy of one of the members of the Society, the cylinder block of the engine with which Harry Hartz broke the Rockingham speed record was shown. Just after his performance, the valve end broke off allowing the valve to drop into the combustion chamber from whence it was driven through the head making a fairly clean hole in the cast iron. The bent valve and battered piston clearly showed the terrific hammering that was given the parts. A small model of a new right-angle drive caused a great deal of comment as to whether or not it gave constant angular velocity. Mr. Witham, chairman of the New England section of the S.A.E. gave a brief welcome to the Branch and reviewed the modern trend of automotive work.

The plans for the future include a trip to the new Ford assembling plant in Somerville at the invitation of the Ford Motor Co. and one to the Standard Oil Co's service station in East Cambridge. It is hoped that a day's trip to Springfield can be arranged to visit the Rolls-Royce factory and several other manufacturing concerns of interest.

CIVIL ENGINEERING SOCIETY

A very successful supper meeting was held in North Hall on January 13th. The members had the pleasure of listening to Mr. G. Howard Perkins, Vice-President of Warren Brothers Co., International Road Builders. Mr. Perkins spoke on the world-famous Columbia River Highway and also on the general subject of Highway Engineering. The talk was illustrated with slides.

The great care taken by the builders in making the Columbia River Highway a marvel of scenic beauty is very impressive. In the case of the construction of the many stone retaining walls along the highway two Oregon men, very much interested in the project, imported from Europe men skilled in the building of such walls, thus there was incorporated in the construction a bit of foreign handicraft and incidently some of the famous stonewall work in Italy was duplicated.

On the evening of March 2nd the Student Chapter held a meeting in North Hall. The Chapter was very fortunate in securing Mr. G. R. Strandberg, hydraulic engineer for Stone and Webster, Inc., to speak on "The Conowingo Hydroelectric Development."

This meeting was a decided success, approximately 125 members attended. A supper preceded the talk by Mr. Strandberg.

No definite plans have been considered for the next meeting; but in all probability it will come early in April.

Employment bulletins will be furnished to seniors who are members of the Student Chapter. These bulletins are provided thru the courtesy of the parent society of the American Society of Civil Engineers.

Reginald F. Jacobs, '27

Departmental Notes

PROF. R. F. TUCKER

BUILDING CONSTRUCTION

This new course which starts this month with the beginning of the second term has already received a very considerable amount of publicity and the information contained herein will probably have very little news value as far as the undergraduate body is concerned, but it may be of considerable interest to the many alumni who depend upon The Tech Engineering News to keep them in touch with the Alma Mater.

Course XVII in Building Construction was founded by Louis H. Horowitz, President of the Thompson Starnett Company of New York through a grant from the Louis J. and Mary E. Horowitz Foundation.

The course is devised to equip the student for any department of the business of building that he may desire to pursue. It is based on the Course in Civil Engineering with the mathematics and scientific training generally associated with that profession. In addition there are certain subjects taken from the Course in Architecture, mainly for the purpose of giving the student an acquaintance with architectural history, periods and forms sufficient to enable him to understand the architect's language and point of view. Subjects in building finance, and management, business law and contracts, cost accounting and professional and industrial relations are also included. Finally a broad course, extending over three years, is given in the analysis, details and assembly of the materials of building, whereby the student is given a thorough understanding of the construction methods and procedure covering dwellings, industrial and commercial structures.

In the 2nd year, two problems will be developed, viz.: A Dwelling House and an Industrial Building; in the 3rd year, the student will study an Office Building above grade and in the 4th year he will develop the foundation under it. The procedure for the study of these problems is as follows:- The Student will design and lay out the building under consideration, to quarter scale with all dimensions. He will then proceed with the study of the materials commonly used in its construction in all its parts, their details, quantities and costs, stimulating in so far as possible the sequence of the actual field operation. Instruction will be given simultaneously with the development of the structure, and in so far as possible, the student will apply the scientific and professional training of the other parts of the Course, to the problem in hand.

Our recent Course XVII in Building Construction, having an existence of only two months has not had a chance to become very well known. The head of this new department hopes many will feel that their interest shown in regard to the workings of the course will be profitable both to them and the course and that they will feel free to attend lectures given in it and inspect the work the students are doing.

The training will include, as a study of the accompanying tables will show, applied mechanics, materials testing, the chemistry of explosives, cements and protective coatings, rock formations and soil mechanics, surveying the design of structural steel and reinforced concrete and masonry. Special attention will be given to banking and investment problems and engineering administration to enable the constructor to meet the broader phases of his work, and the business training will encompass such subjects as business law, (corporate and real estate law) insurance, estimating and cost analysis.

A properly qualified constructor must be competent to receive plans and specifications for a building and to go into the field and erect it in the most economical and expeditious manner.

While the constructor is not primarily concerned with the design of a structure he must have an understanding of the engineer and the architect. The fact that adequate training is necessary in order that large forces of men engaged on construction work may be intelligently directed, and the many human problems involved be successfully coped with, is one that is becoming more and more realized, and the giving of this training is one of the important objects of the course.

The Program is as follows:-

First Year

Chemistry
Descriptive Geometry
Graphics
English and History
Mathematics
Mechanical Drawing
Physics
Architectural Drawing (Special)
Military Science
Physical Training

Second Year

Applied Mechanics
Architectural History (Special)
English and History
Mathematics
Physics
Structural Drawing (Special)
Building Construction (Special)
Military Science

Required Summer Courses

Plane Surveying and Fieldwork (Special)
Graphic Statics

Third Year

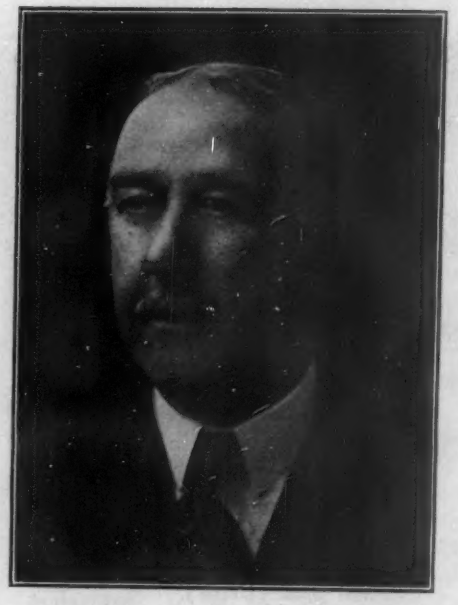
Applied Mechanics
Elements of Electrical Engineering
Electrical Engineering Laboratory
Hydraulics
Geology
Political Economy
Accounting
Materials
Structures
Industrial Relations
Chemistry (Special)
Building Construction (Special)
General Study

Fourth Year

Mechanical Equipment of Buildings
Electrical Equipment of Buildings
Building Finance (Special)
Business Management (Special)
Structures
Testing Materials Lab.
Foundations
Soil Mechanics (Special)
Job Management (Special)
Prof. Relations
Reinforced Concrete Design (Special)
Testing Materials Lab. (Concrete)
Building Construction (Special)
General Study
Thesis

As will be seen from the above table, the course extends thru four years and leads to the degree of Bachelor of Science.

R. F. TUCKER
Professor in Charge.



PROF. C. M. SPOFFORD

CIVIL ENGINEERING

The recent occurrences of note in this department are three in number; Professor Spofford's lecture before the Society of Arts, the convention of the Massachusetts State Association of Master Plumbers, and the lecture of Professor Terzaghi before the Highway Section of the Boston Society of Civil Engineers.

Professor Spofford's lecture was delivered on the subject of "Engineering —The Foundation of Modern Civilization". It was profusely illustrated by lantern slides and in addition actual experiments and a motion picture were shown. In the introduction, Professor Spofford pointed out what engineering is, giving a review of the growth in importance of engineering, its different phases, and finally the dependence of modern civilization upon it. In regard to present engineering, Prof. Spofford touched on the following subject:

"Transportation and the Engineer,"
"Water and the Engineer,"
"Bridges and Other Structures,"
"Materials of Engineering,"
"Polarized Light and Its Application to Engineering Problems."

The lecture ended with a motion picture of the steps in converting water power into electric power.

The conference of the Massachusetts State Association of Master Plumbers was held on February 16th and 17th. It was one of the most successful conferences ever held at the Institute, having an attendance of 477 persons. This is the first attempt in this section of the country to help members of the plumbing industry to realize the importance of scientific research and assistance as a means of solving plumbing problems. The first session began in the morning with an address of welcome by President Stratton. This was followed by an explanation of the purpose of the conference given by Professor R. G. Tyler, Professor E. F. Miller closed the session with a discussion on "Suggested Changes in State Plumbing Laws." Three lectures were given that afternoon by Professor A. W. Hanson, Mr. James Holt, and Professor G. E. Russell on the respective subjects "Distribution of Overhead Costs," "Hot Water Heating Systems," and "A Hydraulic Laboratory Demonstration." At the evening session, Professor S. C. Prescott gave the lecture on "Natural Methods of Waste Disposal." The session ended with a motion picture of the Brockton sewage disposal plant.

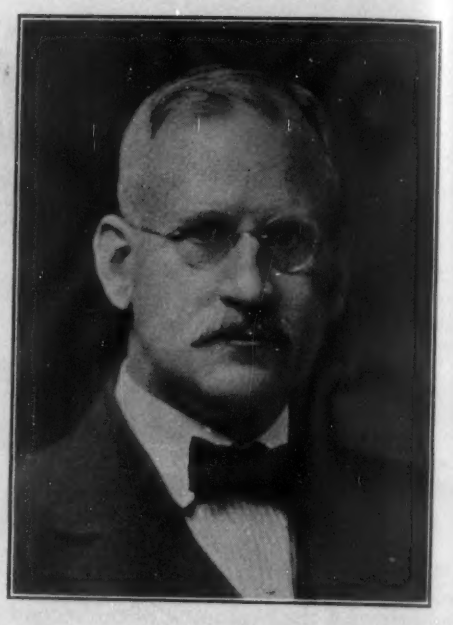
The morning addresses of the 17th were as follows:

"Hydraulics of Plumbing Systems" by Prof. G. E. Russell, "The Water Analysis and the Problem of Corrosion" by Prof. R. P. Russell, "What Actually Happens in the Septic Tank and Cesspool" by Prof. Murray P. Howard, and "Domestic Hot Water System" by Mr. James Holt.

In the afternoon, Professor R. G. Tyler gave the lecture on "Capacities of Plumbing Systems." He followed this with an actual experimental demonstration of the conditions of flow in soil pipes. Opportunity was given at this time for those present to express their reactions to the conference and their ideas for plans in the future.

The lecture of Professor Terzaghi was given before the Highway Section of the Boston Society of Civil Engineers on February 23rd. This address pointed out the relation of soil mechanics to concrete road construction. Professor Terzaghi gave a description of the methods used by the U. S. Bureau of Public Roads in soil classification, and also pointed out a very interesting parallel between the system of investigation followed by the medical profession and the plan of the investigations now being conducted by engineers along the line of soil mechanics.

News has recently come from Professor Hale Sutherland, who is now on one year's leave of absence in Constantinople. He is at Roberts College, teaching the diversified subjects of water power, geology, hydraulic design, reinforced concrete, and applied mechanics. Although Professor Sutherland tells us that Constantinople is very interesting, we can understand when he also says he will be glad to be back at M. I. T.



PROF. S. C. PRESCOTT

DEPARTMENT OF BIOLOGY AND PUBLIC HEALTH

The past few months have shown continued evidence of the varied research work carried on in this department. At the recent annual meeting of the Society of American Bacteriologists held in Philadelphia with the American Association for the advancement of Science, a number of papers were presented by members of the staff and graduate students in conjunction with Prof. Prescott. Among them was a discussion of the disinfection action of soaps on various types of bacteria, by P. L. Riley '23, instructor. Results of a study on the microorganisms concerned with the deterioration of fibres used in cordage were announced by P. K. Bates '24. Doctor K. Morikawa, '27, a research assistant, reported the discovery of a new bacterial organism which has been found efficient in the production of butyl and isopropyl alcohols. Several organisms are known which produce butyl alcohol in quantity but this is the first which has been reported as a producer of isopropyl in quantity. Butyl alcohol is extensively used as a solvent in the motion picture and automotive industries, and isopropyl alcohol is said to serve equally useful purposes. W. P. Dolger '26, gave a paper on the effect of bacteria in the coagulation and putrefaction of rubber latex.

That the option in Technology of Fisheries has been recognized is apparent by the registration in that course of three students from foreign countries, namely Siam and the Philippine Islands. The two students from Siam are sent by the Siamese

(Continued on page 102)

Thermit Welding

An article describing the welding of large pieces by this method

J. H. Deppeler
Chief Engineer, Metal & Thermit Co.,
Jersey City

WITHIN the past few years a great deal of interest has been taken in the welding industry. Welding formerly was used only for repair work and the results were always doubtful. Early welding was done exclusively by the oxy-acetylene process. This process does produce good welds but the skill of the operator and the general conditions of the work has a great effect on the ultimate strength of the weld. The oxy-acetylene process has been further developed and is very satisfactory in its present form for the welding of small and irregular sections.

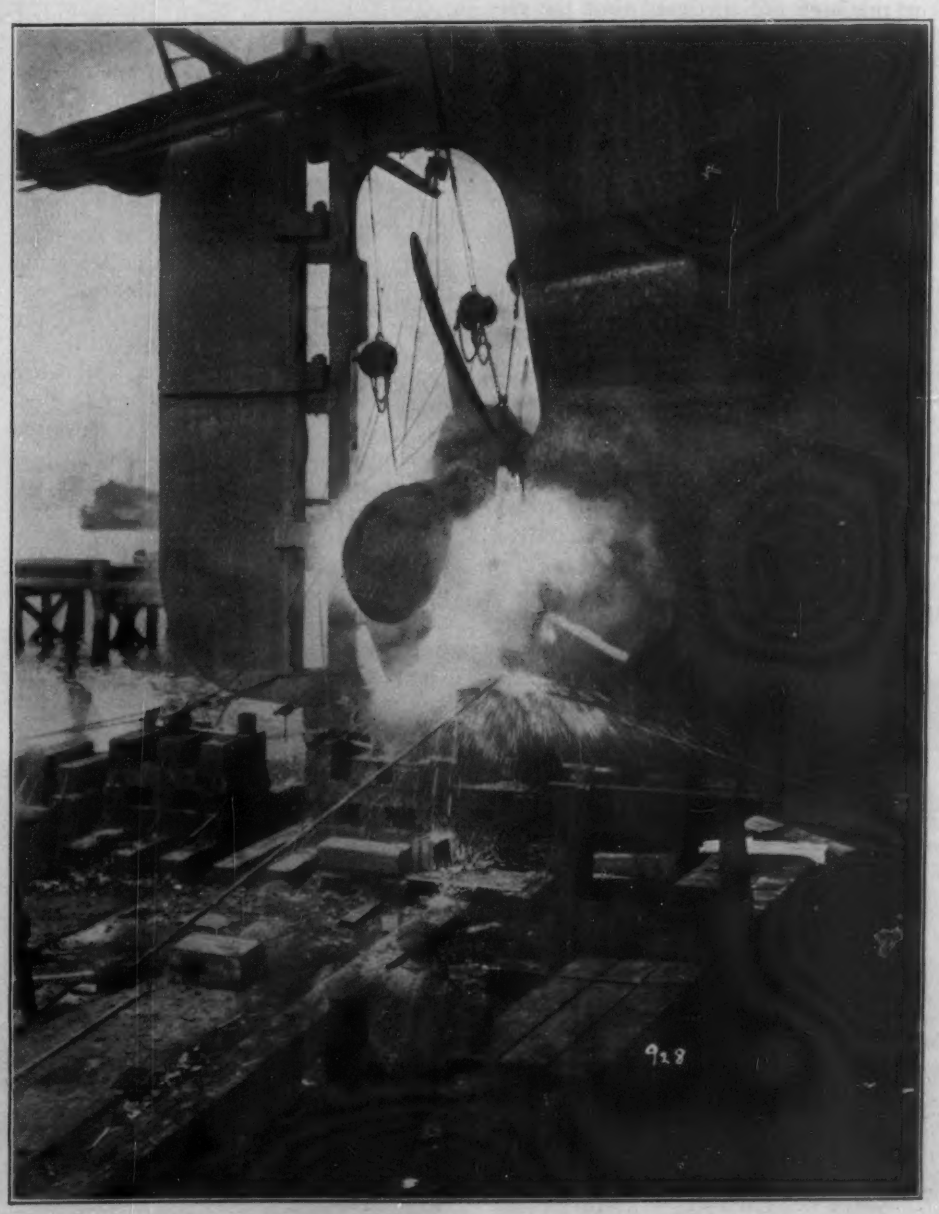
Modern production work required a method of welding which could be manipulated by unskilled labor at a low cost. This demand was supplied by the various forms of electric welding machines. These machines give very satisfactory results on quantity production of similar pieces but involve a large initial expense. Furthermore they are not readily portable and can be used to best advantage only in a factory.

Many engineers early felt the need of a simple and inexpensive method of welding which could be readily applied to large and unusual pieces. Thermit was developed to meet this need. The chemical process had already been used in the production of chromium and other metals so the process was not an unusual one. Thermit equipment is cheap and readily portable thus lending itself to many unusual industrial applications.

Thermit welding depends less upon the skill or manual dexterity of the operator than other welding processes. In general, a thermit weld is made by providing a small gap between the fractured ends, surrounding these ends with a refractory mold, and pouring between and around the ends a highly superheated molten steel having a temperature of over 5000° F., which molten steel gives up its superheat to the parts to be welded, melts them and solidifies with them to one solid mass.

In detail, the process comprises the following steps: A straight sided gap is provided between the fractured ends by cutting away the metal with an oxy-acetylene torch. The width of this gap is proportional to the size of the section and is given in tables provided for the purpose. Then, yellow wax made plastic by warming is placed between the ends of the sections and molded into a collar, semi-circular in section, surrounding the ends. As soon as the wax hardens, a molding material mold is rammed so as to completely surround the sections and the wax pattern with provisions for heating gate, pouring gate and riser. The mold being finished, a kerosene and air flame is directed into the heating gate until the wax is melted out, the mold thoroughly dried and the ends of the pieces thoroughly heated and expanded. Then, the heating gate is plugged, and the thermit crucible having been positioned over the pouring gate, the charge is ignited. In about thirty seconds, the thermit reaction is complete and the charge, which consists of a pure highly heated molten steel in the bottom of the crucible, on top of which is a highly heated molten alumina, is tapped into the mold where the steel fuses with the sections and solidifies with them. All of the operations—the dimensions of the wax collars, sizes of gates and risers, weights of wax and the amounts of thermit—are given in detail in tables with which every thermit operator is

(Continued on page 100)



POURING THE THERMIT STEEL AT 5000° F.

The metal is coming from two crucibles simultaneously to make two separate welds on the stern frame of a large freighter

The Engineering Field

Abstracts from the leading professional and trade journals

Scrap Iron Briquettes for melting in the cupola of the cast-iron foundry of Dodge Brothers, have resulted in marked savings. Utilization of iron scrap in the form of borings and turnings produced in large numbers in the various shops had been previously attempted without success. A new machine has been recently developed which has solved the problem in a most unusual way.

The scrap about the plant is collected and placed in a large hopper over the briquette machine, whose essential parts are two opposing pistons moving back and forth with a common cylinder. The various components of the machine are so timed that the entire operation is automatic; requiring the attention of one man. First a loading port is uncovered and the borings and turnings drop into the cylinder filling a predetermined space, so that the quantity received is constant. The port closes and a total force of 250 tons or 40000 lbs. per square inch is applied to form the briquette.

After the pressure is released, it is ejected into another hopper and then goes on to be melted down in the cupola.

These scrap iron briquettes are four inches in diameter and three inches high, in the shape of a right circular cylinder, and weigh about seven pounds. Since their density is but 10% less than that of solid cast iron, an idea of the compactness may be obtained. No binder is used in the process, yet the high pressure brings about an amalgamating action between the individual pieces of the charge. Chips which occasionally drop out as the compressor chamber opens are red hot, yet the completed briquette does not attain any great heat. The machine has an output of 50 tons every day and night with a saving of 10 dollars per ton and has proved itself to be well worth the rather high cost of installation.

New Use for Porcelain. In making artificial silk, the cellulose solution is pumped into the coagulating solution through nozzles containing many small orifices. Since the coagulating bath contains sulphuric acid, some material that will resist corrosion by the sulphuric acid must be used for the nozzles. Formerly gold or platinum, or an alloy of the two had to be used for this purpose. Attempts were made to use glass for the nozzles, but these were too brittle, and were also affected by the solution.

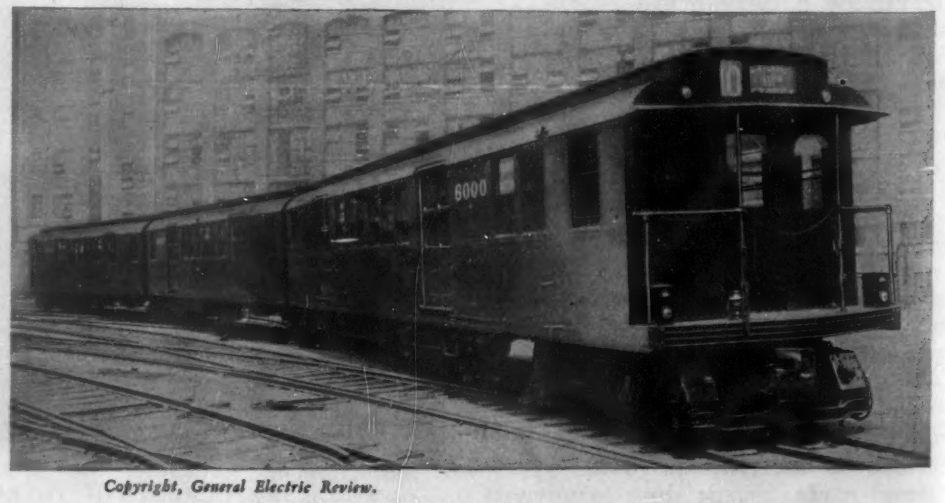
A factory in Thuringia, Germany, has now succeeded in producing a porcelain which can be cut and bored like metals. With the aid of specially designed machinery, they are able to drill accurately the required number and sizes of perforations. Some nozzles have as many as 1000 holes which are of almost microscopic dimensions. It is expected that the use of these porcelain nozzles will reduce considerably the cost of artificial silk.

Irrigation and Drainage rarely go hand in hand, yet both are included in the reclamation of the Salt River Valley of Arizona. When the irrigation project was put into operation, the additional water which was in excess applied to fields and seepage from ditches and canals caused a raising in the level of the ground water so as to render some of the land unfit for cultivation, thus defeating the purpose of the reclamation experts. It was found, however, that the soil formation was favorable to drainage by pumping from wells, and since there was an abundance of cheap electric power, this method was adopted with most satisfactory results.

The water thus obtained is diverted to the irrigation of nearby arid sections, and in this way, one section of land too moist for cultivation is dried, while another too dry for farming receives the necessary moisture, and both are made fit for plant growth. Over a hundred wells were used, and the cost of the project was slightly more than a million dollars, but in five years, practically all of the land in the entire area was made suitable for farming, at a yearly operating cost of but thirty cents per acre.

The Saluda River Project for hydro-electric development in South Carolina will make possible a greater source of power than that afforded by Muscle Shoals. The undertaking, which will require two years to complete, will have a rated annual output of 300,000,000 k. w. hrs. The proposed dam will be the largest in cubical content in the world, over 8000 feet long and almost 200 feet high. The reservoir created will be over 30 miles long and will have an average width of three miles, and in case of a drought for twenty-five consecutive weeks, it will still be possible to supply the dependent mills with 20,000 hp. for 60 hours of operation per week.

Three-Unit Articulated Cars, will soon be common on New York's elevated and subway systems, following the initial installation of 67 of these unusual cars a short time ago. Each of these units is 137 feet long and consists of three separate bodies mounted on four trucks, one at either end of the group, and one under each junction of two of the units. A 200 h. p. motor in each truck serves as the driving force. During the rush hours, with a train comprising four of these articulated cars, a load of as many as 2000 passengers can be readily handled.



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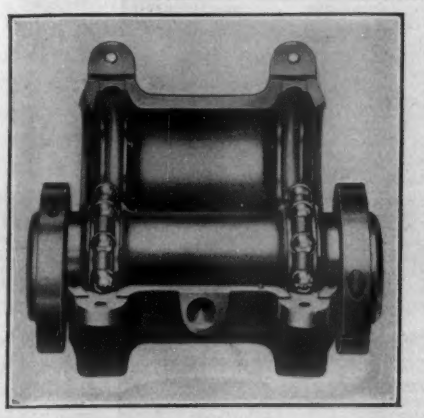
NEW TYPE OF SUBWAY CAR NOW IN NEW YORK

These three-unit articulated cars are a recent development in the Transportation Industry



Copyright, Textile World.
SPLIT BALL BEARING HANGER
May be installed without removing shaft

A New Type Hanger Bearing, known as the Chapman Split Ball Bearing Hanger has recently been placed on the market for use in power transmission. In appearance it is similar to the regular journal hanger bearing, but its construction involves several entirely new features. The ball raceways, both inside and out, are split and permit the bearing to be installed on any line of shafting without moving the shaft.

After being swedged into the housing, the raceways are carefully ground, so that there is a perfect joint at the union of the two halves and when they are tightened down on the shaft the surface is as smooth as that of an unsplit raceway. In this way, there is no danger of balls chipping and cracking upon sharp edges.

An unusual method is used in separating the balls from one another. Instead of the usual steel roller, a hollow tube containing a smaller ball is used, and the load carrying balls are carried by balls themselves. No contact is made with the metal separator and consequently all sliding friction is eliminated, while the little rolling friction present is reduced to a minimum and lubrication is required but once or twice a year.

The Spraying of Metals, a process developed by Dr. M. U. Schoop of Switzerland, has been found to have important industrial applications. It produces a metallic coat or layer on any object regardless of its material, size or shape, using metals with high melting points with equal facility as those whose melting points are low.

The apparatus used is known as the "metal spray gun," and the metal used is introduced in either wire or powdered form. In passing thru a nozzle, it is melted by an oxy-acetylene flame and at the same time is caught in a stream of compressed air leaving a second nozzle, arranged concentrically around the first which atomizes it and sprays it against any object held in its path. The particles leaving the gun have a velocity of 1000 feet per second, and consequently the metal enters into the smallest cavities and pores, resulting in a firmly adhering coat.

It was found, however, that the sprayed metal contained considerable oxide due to the high temperature used and the abundance of air present. A more recent model makes it possible to produce a practically oxide-free coating by melting the metal not with a flame, but with the gas itself. Carbon dioxide or nitrogen is generally used, at a temperature above the melting point of the metal to be sprayed. The gas also atomizes the metal and sprays it in coats having the character of pure homogeneous metal.

The use of the "metalspray gun" is particularly important in the rust-proofing of iron and steel. Zinc is the metal used and the result is similar to galvanizing, while the thickness of the coating may be varied from a few thousandths of an inch to practically any dimension desired according to the length of time the metal is held in the spray.

In the printing industry the invention has a most important application. To make electrotypes, a wax negative is covered with graphite and then copper plated for about eight hours to form a thin sheet which when "backed up" with type metal, is a reproduction of the original page or plate. The new method is to cover the original with a little grease so that the sprayed metal will not adhere to its surface, but can be easily removed. In this way a form or mold which is an exact duplicate in the negative of the original can be made in a few minutes while the old method requires hours for its completion.

An Induction Lamp having no physical connection with the circuit on which it is used has been recently developed by the makers of the Cooper-Hewett mercury vapor light. A large glass bulb, somewhat similar to that used in the larger conventional type lamps has placed in it a drop of mercury about the size of a pea. It is then exhausted to a very high vacuum and subsequently filled with some inactive gas such as argon or neon at a very low vapor pressure. Around the lamp is a helical coil of seven or eight turns of wire carrying a high frequency current at a rather low voltage. The negative electrons of the gas in the bulb, when excited by the field produced in the coil, are supposed to increase temporarily their orbits of rotation. On coming in contact with other electrons, they give up their energy and return to their original orbit. It is this moving of the electrons back and forth between different orbits that brings about the light radiation.

A Steam Turbine Generator is now being operated at a pressure of 1200 pounds by a Milwaukee public utilities concern. This is between three and four times the average pressure in use, and is equalled only by the 3000 KW. turbine generator at the Weymouth station of the Boston Edison Company. The Milwaukee machine sets a record, however, in that it has a capacity of 7000 KW., which is more than twice the output of the Boston machine. Steam is received, superheated to 720°F, and at a pressure of 1200 pounds per square inch. It is exhausted at 320 pounds pressure, and goes to large low-pressure 30,000 KW. machines where more energy is extracted.

Power from Pulverized Lignite is now being sold by an electric generating company in Texas. This state has no coal deposits, altho lignite fields are in abundance. Lignite is a carbonaceous material containing about 33% water, and stands midway between peat and bitumen in the geological formation of coal. It is hard to burn under ordinary conditions, but when pulverized by means similar to that used with coal, combustion takes place readily and power can be very economically produced. Heretofore, little use has been made of the enormous Texas deposits, but it is expected that the use of pulverized lignite as fuel for power generation will create a demand for this natural resource.

No, it isn't a haystack in the background, but 7,000 yards of rock caught by the camera at the instant the blast was fired
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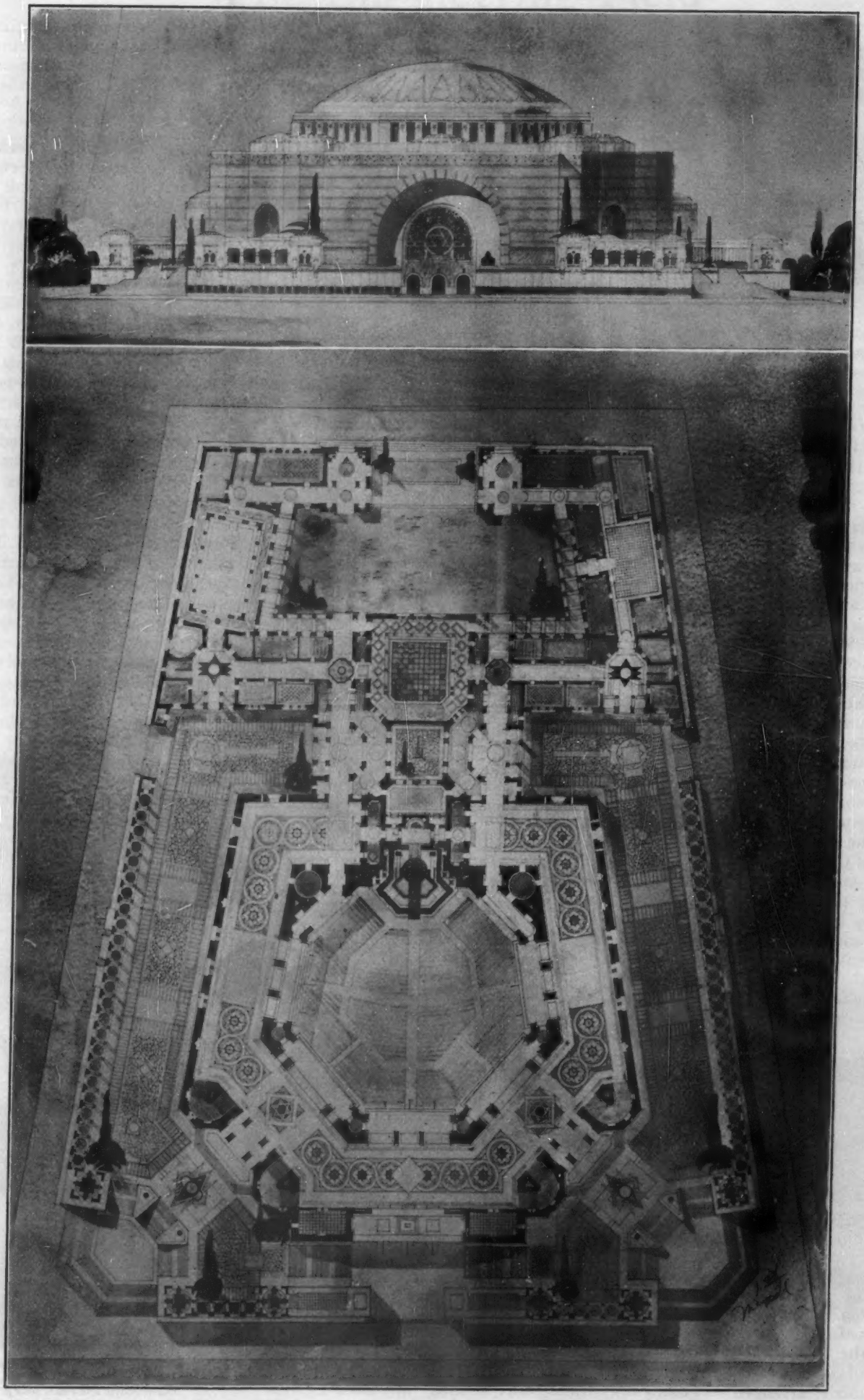

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Editorials

PUBLIC SERVICE SECTION

A Public Service Institute was held at Technology this month to discuss the significance to the community of every form of public service and the necessity of trained personnel for effective administration. This Institute was held under the joint auspices of Technology and The Massachusetts Civic League. It is quite fitting that Technology should sponsor such a meeting as in the past it has taken the lead in matters of pure engineering and is now very actively developing the new engineering science which recognizes economic and social forces as well as the material and natural forces. *The Tech Engineering News* as the professional journal of the undergraduates felt that the papers presented at this conference were of lasting value and should be preserved. To this end we have devoted a large portion of this issue to a report of the various sessions of the institute. We realize that all of the material presented as well as the discussions are of great value but we could not possibly publish them all due to space limitations.

We hope we have contributed something to engineering literature in this presentation. As a result of this institute and of our endeavors to provide a permanent record of its proceedings, American civic life can be bettered, we will consider ourselves amply repaid for all our efforts.

We trust that those in responsible positions who attended this conference left with a broader outlook on the field of Public Service and will be better able to administer their work to the good of the American people.

SACRIFICES TO PROGRESS

Practically all those having an interest in work of an engineering nature have become familiar with the details of the new hydro-electric development at Conowingo, whether from the standpoint of civil, electrical, or mechanical engineering. Yet, in the mass of information which is to be found upon the subject, there is one fact which seems to be of particular significance. With the project less than half completed, five men have already been killed on the job.

This is but a typical instance of the toll exacted by industry in every field. The number of those killed and maimed while in industrial pursuits in a single year is appalling and cannot but cause thought. It has been stated time and again that many of these accidents are preventable, and, if such is the case, our present system is woefully at fault.

We look at the beautiful skyscraper, the roaring steel mill, and the fast express, marveling at the achievements of our twentieth-century civilization, but we little realizing that in the construction and operation of these symbols of progress, human lives have been and are being taken. Is it necessary that the wheels of progress must crush out the existence of a few that the many may find life richer and fuller?

Safety conditions of today are a vast improvement over those of ten years ago, yet there is still much work to be done. The safety engineer is a vital factor in many fields, yet his work can be further applied to job after job without end. It is the duty and the privilege of the technical graduate, as a professional man, to see to it that the safeguards for the lives of his fellow men are constantly increased and that in the future, the threat of death and permanent injury shall not be a constant burden to our millions of workers.

OPPORTUNITIES

Most of the Undergraduates at Technology do a good deal of thinking about what they are going to do after graduation and most of these men wish at some time that they could find some great opportunity as did Ford in his new vision of standardization and quantity production, or as did Edison in his work with the electric light lamp, or as did Langley and the Wright brothers with the aircraft. However, the outlook in this age of science seems to leave the discovery of new principles to specialized research investigators, with small benefit to the investigators. New applications for old principles is the field, then in which to search. But only a few of us are startlingly successful here also.

There are real opportunities waiting before us, but, they must be seen. An example to illustrate what is meant may be helpful to convey the idea. A man has recently found his opportunity in the field of furniture manufacture. That may sound awfully dull, but don't let yourself be fooled. Furniture is made today by the same methods as were used three hundred years ago. Machines to do various operations have been developed and improved but everything is done piecemeal, including intermediate handling of the material. Here we have an ideal stage setting for someone with a few ideas.

The man with the ability to discern the opportunity has appeared and with him he has some ideas. His first project is a scheme for the utilization of waste lumber. It is a semi-automatic layout. The odd pieces of waste are fed into a hopper at one end of the machine and the completed panels come out at the other end. Other schemes have been devised to make furniture or any wooden product on a production basis in an automatic plant.

Now the question is, why didn't you and I discover this opening and make use of it? Well, we didn't, that's all. But there are others, so let's get busy and find them. If we don't, someone else will.

THE COVER

The etching reproduced on the cover for this month's *Tech Engineering News* is by Joseph Pennell. This picture taken from the *Nation's Business* shows New York as one sees it from a Jersey ferry. The towering skyscrapers of lower Manhattan form a background for the approaching ferries.

WINNING DESIGN

Mr. W. E. Campbell, one of our architectural students, won first mention for his design of a synagogue in the Beaux-Arts competition.

The plot of ground is a truncated isosceles triangle with the base 500 feet on an important boulevard, the length of the parallel side 300 feet and the altitude 580 feet. The plot has wide important streets on the two non-parallel sides with a minor street in the rear.

The requirements were:

For the Synagogue proper an auditorium with seating capacity of 8,000 including all galleries, an ample lobby or lobbies used especially at the important religious holidays, coat room, toilets, a speaker's platform, a choir gallery for eight or ten singers and organist, organ space, Rabbi's study and library, and an Assistant Rabbi's study.

A semi-detached building or buildings of several floors, known as the Social Center, whose range of activities have three principal divisions:

A Sunday School having about thirty-five small classrooms at least seven of which shall be on the first floor, a large auditorium on the first floor for Sunday School assemblies, lectures, motion pictures, dances and occasional dinners, consequently kitchen services should be provided on the same floor.

A Women's Club having a director's room, parlors, reception room and reading room on the first floor.

Mr. Campbell's prize design is shown on the opposite page.

Recent Books

This department conducted in co-operation with the faculty

"Leached Outcrops as Guides to Copper Ores." By Augustus Locke, 175 Pages Bibliography. Published by Williams and Wilkins Company, Baltimore, 1926. $5.00. 24 Illustrations.

Prompted by the growing difficulty of ore discovery and the need that exploration be made more efficient, the author purposes to predict sulphide copper ores by the use of leached outcrops, since the surface of the ground is the cheapest and most accessible level on which to work. This, he accomplishes by correlating into this book previous field experiences of qualified workers chiefly in the Southwest.

The reconstruction of the sulphide from the metore and the use of the reconstructed sulphide in the prediction of hidden sulphide copper and iron ores are the main topics. Since iron is common to both the ore and metore, which consists of the capping and the gossan, the iron's migration and its form in the metore are shown by the author to be related to the ore, so that a determination can be made of the value of the sulphide as to its iron and copper content.

Then after dealing thoroughly with the chemistry of iron migration in the oxidized zone, the book shows the use of different types of gangues as indicators of certain kinds of sulphides, and explains how some gangues promote the formation of acid, so that the iron is carried away and hence is not generally an indication of copper. As voids are necessary for copper mineralization, they are also taken up in conjunction with oxidation collapse and slumping as guides to hidden ore bodies and to their composition.

This is followed by a discussion of the actions and relations of metals in non-sulphide form, as gold, silver, arsenic, lead, and zinc to copper. Then the author, realizing the value of relict sulphide as a very specific guide, shows its relation to the ore beneath, and only its scarcity prevents it from becoming more significant than the iron precipitates themselves.

The latter part of the book deals chiefly with iron precipitates and the different kinds, since they are more abundant, more constant in their behavior, and better understood than are other indicators. A sufficient number of these kinds mean exclusively that a particular kind of sulphide was the original ore. For an example, a light colored square "limonite" boxwork replacement often means the ore was originally rich in copper. Then the author discusses the methods of determining the direction of the ore, the thickness of the metore, the grade of the enriched sulphide and its thickness, and completes his work with a summary.

This book is systematically arranged into fourteen chapters all of which are ably written. The author in realizing the originality and importance of this field, succeeds in presenting his subject both clearly and emphatically. For this reason, the reader is impressed by the thoroughness with which the author has correlated the facts and the manner in which he has presented them. Then to further clarify the description the book contains important illustrations, and following the glossary and index, there are twenty-four plates showing the different occurrences and formations of iron ores in rocks that are related to the original sulphides, occupying those positions. The work, although it has accomplished much and has fulfilled its purpose, offers many problems and new ideas to be worked out.

G. P. W.

"Astronomy To-day." By T. H. Morcox, Director of the Observatory of Bourges. Translated by C. F. Russell, New York, E. P. Dutton and Company, 1926. G2 Illustrations. 256 pages.

His volume has considerable value for those who have an interest in astronomy as a cultural subject. It sums up in a single, direct, straightforward manner the substance of the modern thought in this interesting science in a very readable way. The translator has succeeded in keeping in the English version the simplicity and directness of the original French.

It contains a chapter on the sun in which the radio activity theory or basis for the sun's power is explained. There are chapters dealing with the Earth, the Moon, Mars, the planets, comets, stars, nebula, etc., as well as chapters on the more general problem of distance in Astronomy and the evolution of stars and stellar systems. These make the book very entertaining and profitable reading.

"The Principles of Physical Optics." By Ernst. Mach. Translated by John S. Anderson and A. F. A. Young, New York, E. P. Dutton and Company 1926. With 10 plates and 280 diagrams. 324 pages.

An historical and philosophical treatment in which the author sets forth the general concepts of Physical Optics, together with the historical course of their development.

He shows, from a critical and psychological standpoint how the ideas concerning the nature of light have been variously formed and interpreted; what transformation they have undergone by reason of the discovery of new facts, and the conclusions arising from them; and how, from the resulting theories, the general concepts of optics have developed.

To the student who is interested in the historical development of the subject, but has neither the time to read the original works of Newton, Fresnel, etc., nor perhaps the faculty of advising the true values of the various theories, this book affords a complete survey of one of the most fascinating branches of science.

"Motor Vehicles and Their Engines." By Edward S. Fraser, and Ralph B. Jones, New York, D. Van Nostrand Company, Third Edition, Revised and Enlarged. 434 pages.

The book has a three fold purpose to serve as guide for the personal instruction of the car owner, as a handbook for chauffeurs, garages and repairmen, and as a text book for automobile schools. The treatment is simplicity itself, and the technicalities have been reduced to a minimum. The fundamentals of gas motor operation, as well as the care and operation of the principal accessories of the motor vehicle concerned are discussed in detail and at great length; this is the usual practice.

The third edition has permitted a revision and thorough modernizing of the material and an introduction of much new matter descriptive of the many recent mechanical improvements. It is an attempt to collect in a comparatively small book such elementary, theoretical and practical information as will assist in the operation, up-keep and adjustment of motor vehicles.

The book is an excellent practical treatise on the automobile and should be part of the library of every car owner who takes a pride in his machine.

"The First Year of Science." By John C. Hessler, Ph.D., Professor of Chemistry, Knox College; Benj. H. Sanborn & Co., Boston. 576 pp. 329 illustrations.

This book, intended for the use of students in the first year of high school, is a revised edition of the earlier work published in 1915. It has been completely rewritten and brought up to date in every respect, so that it presents a clear and concise picture of the field of science in everyday life. The language is simple, and no previous scientific knowledge is assumed. Consequently, the book is ideal as an introduction to the study of physics and chemistry which follow.

The first part of the book takes up the natural world about us. It begins with a study of the air, its nature, and applications. The effects of air pressure are developed in detail. This is followed by a chapter devoted to the subject of heat sources and measurements. Carbon dioxide, the natural product of combustion is the next topic, which leads to the subject of ventilation. The discussion of the atmosphere is followed by a chapter on water and its uses, in which a little elementary chemistry is introduced.

The next group of chapters is concerned with the earth itself. This starts with the subjects of force and inertia, explaining the action of gravity and various natural forces. An excellent chapter on the weather presents interesting explanations of all natural phenomena. A new chapter on the heavenly bodies has been added, introducing the subject of astronomy in such a way as to arouse the interest of any normal student.

Following this is a discussion of the relation of science to the things about us. Magnets and electricity are first treated with explanations of the various pieces of electrical apparatus in everyday use. A chapter is devoted to the study of light and its uses, and the microscope, periscope, and motion picture camera are taken up in detail. Sound brings up the discussion of the phonograph, musical instruments, and the radio. Almost an entire chapter is devoted to the subject of radio telephonic communication, both in sending and in receiving. More chemistry is introduced with the study of acids and alkalies and a description of soap and various methods of cleaning. Simple mechanics are next outlined, and the study of machines continued with the airplane, steam engine, and automobile.

The concluding portion shows how science enters into our actual life. One chapter deals with scientific agriculture and the proper use of fertilizers. Our food is next discussed and various diets recommended. The plant world and the animal world are the subjects of two chapters dealing with the conservation of resources and animal life. Next follows a study of physiology taking up the human body, circulation and respiration, and the nerves and sense organs. The final chapter "How to Live" gives simple laws for health and community well being.

As a whole, the book is suited for use either as a classroom text or for outside reading. Its style is interesting and the reading of the various chapters is not difficult. The arrangement of subject matter is logical and natural In conclusion, "The First Year of Science" is a book in which any first year student in high school should be deeply interested and a book the study of which should be a pleasure.

H. S. G.

The Model Schooner "June"

A description of a beautiful model schooner loaned to the museum of the Department of Naval Architecture

By C. R. Mabie
Department of Drawing,
Massachusetts Institute of Technology

THE Naval Architectural Department of the Massachusetts Institute of Technology has lately made a new acquisition to its museum. This is a model of a fishing schooner, fully rigged and ready for sea which has been lent by the builder. As designed and built by Mr. Prescott T. Whitfield, Manual Training Teacher at the Western Junior High School, Somerville, she embodies features of both the Gloucester and Lunenberg boats.

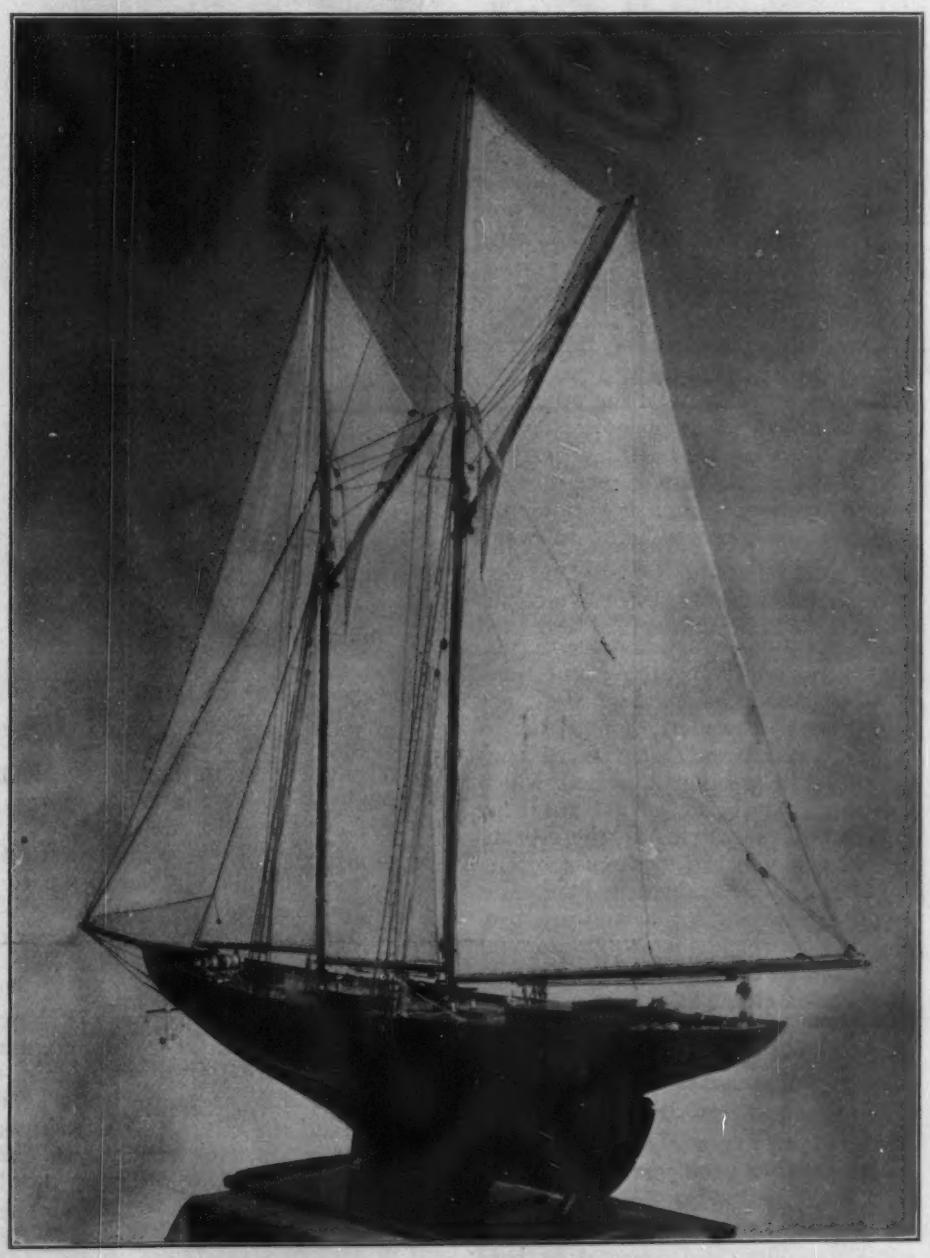
Built to a scale of one half inch to the foot, her seventy-three inches on deck and sixteen inch beam represent the dimensions of a vessel of the larger type. Planked without and ceiled within, all mahogany, caulked with white lead, brass fastened and varnished, she is a sturdy craft, well suited for fresh or salt water sailing.

The rigging and gear are as true to life as any sailor might care to make them. Real sheaves turned from brass are in the blocks while other metal parts are cut from copper and aluminum. The aluminum anchors are a work of art. The windlass works the chains, although as Mr. Whitfield says it is not the type actually in use. Two dories, one port and one starboard, add a touch of reality to the deck. Eight or more are carried by our Boston schooners when fishing.

Several ingenious devices are met with upon close examination. For instance, a brass gas light tip serves very well for a galley stove pipe and a mandolin key forms the mechanism of the rudder, which works much better than some real ones the writer has struggled with "down on George's."

This boat is not a model of a yacht but of an every day, sea-going implement of business. She is not so highly polished as to lose her character. Her deck and sides do not show the luster of a mantle-piece ornament and in this respect she bears a convincing resemblance to her larger counterpart. The reality of the hard life "off shore," the heavy seas that sweep from stem to stern, the high gales carrying rain and sleet, foam and snow that so test the staunchness of a vessel, alone reminds us that it is but the miniature of a vessel that would bring her company safely home with a full catch.

No account would be complete however without a word or two concerning her builder. Born and bred in Nova Scotia, the birthplace of many a sailor and shipbuilder of note, Donald McKay among others, he early came to know the parts and handling of all kinds of ships. His father, a veteran of the ship yards, furnished no small amount of the life and enthusiasm so characteristic of his work. Mr. Whitfield fashioned his first boat at the age of twelve and has never tired of this branch of craftsmanship. His sea faring days, as sailor and mate, served to give him not only a practical knowledge of vessels, but an intimate acquaintance with their personalities. This ability to interpret the personality of his work is absolutely essential to the master craftsman. Mr. Whitfield, in the "June," has caught the personality of a fishing schooner and herein lies her greatest claim to more than passing notice.



MODEL FISHING SCHOONER "JUNE"

Details of rigging and equipment are worked out with extraordinary care. Even the dories are equipped, down to tiny brass bailing scoops

The Public Service Institute

This section is devoted to abstracts of the papers presented at M. I. T., March 16-18, by leading men in the field of public service

THE Public Service Institute was opened with a banquet at the Hotel Somerset, Wednesday evening, March 16, to discuss the social significance of the public service. Dr. S. W. Stratton, President of the Massachusetts Institute of Technology acted as toastmaster.

In opening the meeting, Dr. Stratton commented on the need of technically trained men in the various government administrative positions.

In the past our laws have too often been made by people who were absolutely unfitted to meet the problems at hand. President Stratton pointed out the part Technology has played in the past in training men for executive positions, and the opportunities for service in the future. The first speaker of the evening was, His Excellency, Alvan T. Fuller, Governor of the Commonwealth of Massachusetts.

The main substance of the Governor's talk is as follows:

The comfort, the welfare, the safety and the health of all of us depend upon the correct solution of the problems of government. The people of our country have all too slight a realization of the vital importance of the correct handling of their governmental problems to their well-being in every minute of their daily lives.

In my position as Governor, I find myself studying at one time or another all the questions which you are to consider here and many other questions of government which you will not have time to consider. I find that in all these questions, I am faced constantly with another question which must be correctly solved if I am to be able to assist in solving all these problems which you are to discuss.

The question to which I refer is that of preserving a wise and just proportion between the total amount which should be expended for all these purposes combined, and the amount which the people of the Commonwealth ought to be asked to contribute in the form of taxes to finance all of these different activities. I wish to urge you while you are considering all these other problems to remember that every dollar which is spent to solve any of them is contributed by some unwilling and very often hard pressed tax-payer, and to remember that however desirable it may be to expand and improve the services rendered by government, those services should never be expanded unless we are sure that the result will justify fully, taking the money from the people to finance them.

From our small New England beginnings to the present time we have advanced far in our demands for the doing of things at public expense

GOV. ALVAN T. FULLER

which were originally supposed to be furnished at private expense. Our people are demanding more and more that new public activities be undertaken. But at the same time unrest at the increase of the burdens of taxation is growing steadily and rapidly. We ought to cease extending our public service, awaiting the time when our public revenues can catch up with the present demand, unless we can, by improving the administration of our present public service, and by eliminating unwise or obsolete activities thereby save, by a more efficient achievement, sufficient revenue to embark upon new enterprises.

In our own State service we long ago recognized that if each separate department were left to its own devices our public treasury would not longer stand the strain. It is for this reason that we have established our Commission on Administration and Finance whose duty it is to view the State's activities as a whole, properly to measure the relative importance of each activity, and to confine the activities of each particular Department to its own proper sphere.

Each departmental head probably considers that his own department is the most important one in the whole State service. He also probably and very properly thinks that his own department is the very best. Each Commissioner probably feels that the Legislature ought to give him liberal appropriations to carry on his particular work.

With the adoption of the pay-as-you-go policy, the budget system, and with the creation of the Commission and Administration and Finance, our Commonwealth has placed itself in the forefront with regard to solving the problem of allocating our revenue to our necessities in the public service.

At a conference on the increased cost of government which was called at Washington by Secretary Hoover about a year ago, it was stated in the opening address that among forty-eight states, only one had decreased the tax burden of its people imposed by the State Government since 1920. The only exception among forty-eight states was Massachusetts. There can be no doubt that the reason why Massachusetts is the exception to the rule which applies to all the other States of the Union is that we here have progressed further in so organizing our State administration that the Governor is able to have before him, at least in outline, a picture of the entire activities of the State, so that he may try to confine each activity within its proper sphere and to keep the total expense of all activities within bounds. We have also, through the creation of the Commission on Administration and Finance, provided the Governor with an agency, to enable him to keep constantly in touch with all activities and to keep each within its proper sphere.

One of the greatest difficulties with which the Governor has to contend is the activity of people who are very much interested in one activity and who urge the development of that upon the Legislature without stopping to consider in any way the proper proportion which the activity in question should bear to the total.

We need men and women who will do their best to see that all the State's activities are cared for so that none shall be neglected and so that the burden of taxation, upon those of our citizens who are not in particularly

fortunate circumstances financially, shall not be increased.

At the conclusion of Governor Fuller's talk, President Stratton introduced Mr. James P. Munroe, secretary of the corporation of The Massachusetts Institute of Technology and chairman of the committee in charge of the Public Service Institute.

Mr. Munroe outlined the purpose of the Public Service Institute as follows:

The aims of this Public Service Institute are definite and immediate. It hopes to point out, first, that those engaged in public work, being members of the largest, and probably the most important, profession in the world should be inspired by the true professional spirit of research, of efficiency, and of unselfish devotion to the public good.

Second: that while the taxpayer contributes much more through taxation than he did, it is because he demands much more. It follows, however, that, as the liberal supporter of the public services, he has a right to demand a high order of personnel not only free from any taint of graft, but determined to make effective every dollar that the taxpayer provides.

Third: that this high type of personnel cannot be secured unless the compensation is in some degree comparable to that offered by private enterprises.

Fourth: that increased outlay in the hands of trained public servants will result in ultimate great saving.

Fifth: that, in many cases, public service cannot adequately function unless it has the wise cooperation of well-organized private services and foundations.

Sixth: that admission to the public service should be strictly guarded by wise and flexible rules and regulations, and

Seventh: that the universities and colleges have a distinct obligation to train men and women for the public service, an obligation that, as yet, most of them are very far from meeting.

Two things this Public Service Institute wants particularly to stress: the fundamental importance of a scientific classification, in all bureaus and departments, of their personnel. In this direction, as well as in the selection of public servants we have gone far since the days of the dismal 80s; but we have still many miles to go. The second matter which this Institute is endeavoring to point out is the obligation of institutions for the education of young men and women, not only to provide ample opportunity for definite training for the many forms of public service; but also to urge and to assist their graduates to go into a life-work that, while it may not bring the highest returns in money, gives the enduring satisfaction which comes from knowing that one is making a real contribution towards building up a better and more effective order of society.

At the conclusion of Mr. Munroe's talk, President Stratton introduced Mr. Joseph Lee, President of the Massachusetts Civic League who commented on the poor support we give our legislators.

He spoke in particular on the poor judgment we display in civic matters. At the present time a disabled veteran has better chances for entering the police and fire fighting services than one in perfect physical condition who has never been in the services. This condition is obviously ridiculous yet a referendum on the question was recently lost in this state. Our schools too show a lack of real public interest. The visible element of an issue is the personal element. Teachers are in the employ of the state who have no right to teach, yet public opinion has not as yet become crystallized to the point of removing them. Mr. Lee also commented on the pending bill to force all Boston school teachers to live in Boston which is an absurdity. Following Mr. Lee, Dr. Charles A. Beard, formerly Director of The Training School for Public Service in New York, gave a very interesting address. He showed that everything rests on the sound administration of the modern state and that this state embraced more than the armed might of soldiers and policemen, but included the two millions or more civilian servants upon whose skill and competence even the military position of the structure rests. The thought which Dr. Beard laid most emphasis on was that people should take a more scientific and deeper interest in the subject of politics and administrations considered as the science and art of management. Dr. Beard then laid down the following four propositions which he considers incontrovertible and when philosophically considered place the subject of political science high among the intellectual interests of our age.

The first is that technology is the foundation of modern civilization, as the state is its retaining wall. Let the engineers and scientists quit and the whole cultural order would revert to that of eighteenth century agriculture. In that case, electric lights would go out; water would cease to flow in the pipes; silence would fall upon the humming telegraph wires; the printing press would sink down into rust; yellow fever, cholera, small pox, and bubonic plagues would fill our avenues with the spectres of death. Then where would the great and wise stand —the puissant bankers, editors, preachers, jurists, and highbrows generally?

My second proposition is that technology is a new factor in civilization, now at the beginning of its career, an irresistibly dynamic factor which under the drive of business enterprise and the popular demand for comfort, safety, and convenience will hurl into society one epoch-making invention after another, changing, rearranging, and challenging the state, throwing upon it ever-increasing burdens, calling upon it for ever more complicated services, straining its creative and administrative energies to the limits of human capacity—and beyond.

My third proposition is that technology has already turned the state of our ancestors upside down, transforming it from a police state into a service state. For example, there are in the United States at least ten times as many civilian servants as there are soldiers; the City of New York has only fourteen thousand policemen protecting life and property by force, while more than one hundred thousand civilian employees serve it in the discharge of community functions.

My fourth proposition is that nothing under heaven can stop the inexorable march of this modern Cyclops, technology; that on the contrary, it is the high and appointed servant of that noblest concept of the human mind, namely, the subjugation of the material universe to the welfare of humanity, and will march from triumph to triumph in the coming centuries.

The functions of the state are growing. All parties decry the fact yet no party changes the fact. While details may be altered here and there, no party can change the remorseless movement of technology and social forces with their inevitable repercussions in politics.

Out of this multiplication of public functions in number and complexity has grown a corresponding increase in the number and variety of public servants. At the present time about two and one-half million people are employed by our governments, national, state, municipal and rural. Still more significant is the fact that they represent all the arts, crafts, sciences, and professions known to mankind. The list of civil servants in New York opens with arboriculturalists at the top and runs down through architects, civil engineers, electrical engineers, nurses, physicians, to X-ray experts and zymotic disease specialists at the bottom. In a word, all the wisdom and all the talents of humanity, the

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THE EXPERT IN THE PUBLIC SERVICE

Water Supply and Sewerage

Mr. Harrison P. Eddy, of Metcalf and Eddy, opened the meeting with the following address:

THE public service, like practically all activities, has passed through a period of marked change during the passing generation. Thirty years ago highways and town roads were crude affairs in the great majority of cases; pavements were confined almost exclusively to the cities and there, smooth pavements were exceptional. Traffic problems were insignificant compared to those of today. Sewers and drains were designed mainly by empirical methods, and the treatment of their discharges was seldom attempted. Water supply engineering had developed farther than that of most other municipal service, but was far behind the standards of today.

Within this period these activities have been brought to a much higher plane of accomplishment, partly because of improvement forced by the great concentration of population in urban centres, somewhat by the processes of natural evolution and greatly by advancement in the field of science and the application of its principles.

Development in the electrical field has revolutionized the public lighting service, means of transportation and pumping installations. The results of the advance in the automotive field are obvious. The purification of water supplies and the treatment of liquid wastes, have made phenomenal progress. The new science of bacteriology has provided knowledge and the tools which have revolutionized methods and accomplishments in the field of the public health and welfare.

There is a wide difference between industrial and mercantile service and the public service. The former has its incentive largely in the desire for financial profit, while achievement in the latter is much more largely inspired by a desire to render service for the benefit of the public. This desire is by no means free from the effort to gain a livelihood, for even the public servant must have the where-withall to support life and in many, probably most cases, taking into consideration the entire personnel, the emoluments are about as great as in other walks of life, else most of the positions would be vacant. But the incentive of personal financial gain resulting directly from one's efforts, is largely lacking. This condition, coupled with the restraint caused by the web of legal limitations in which the public servant is generally enmeshed, accounts in large measure for such inefficiency as exists in the public service as compared with private enterprise.

Comparatively few experts are appointed to the public service. Where the tenure of office is long some appointees become expert through experience gained at the expense of the public, but generally the duties are sufficiently exacting, the demand upon time is so great and the incentive is so small, that one does his daily task without attempting the more intense application required for study and research which would help him to become an expert.

The substitution, where practicable, of buses for surface railroads, and the removal of tracks.

The construction of underground rail facilities for the delivery of store freight.

The provision of undercrossings for pedestrians at busy traffic points, preferably in connection with the operation of underground rapid transit systems.

The control of the density of traffic by imposing additional restrictions on the height of buildings.

The placing of the burden of providing parking and loading space, at least in part, upon the property owners.

The adoption of more liberal standards for the width of both local and arterial streets in the planning of new territory.

Finally, there are three questions that a completed regional planning program should attempt to answer.

1. What will be the nature and extent of future growth of the region under consideration?

2. What plans and policies are needed to take care of that growth?

3. What sort of a program is necessary for carrying out these plans and policies?

Rarely, however, have such fundamental questions as these been made the subject of a searching analysis, nor the related question as to whether the constant and rapid growth of cities is desirable, what are the collective community losses measured against the compensation, and where and upon whom should the burden of remedying the existing conditions fall.

Furthermore, there are degrees of expertness. The public servant usually can hope for experience in but a limited field. He is confined to the conditions encountered in his particular locality and department, instead of being able to carry out his researches in the broader field afforded by engagements in a large number of places and under a variety of conditions. This results in a limited degree of proficiency in a narrow field, which denies him the breadth of vision, experience and judgment he otherwise would have.

While local pride and lack of appreciation of the importance of expert knowledge and assistance still lead to a large measure of provincialism, there has been a growing recognition of the need of the expert in the public service. The man whose chief asset is that he is a good fellow is not as often as formerly selected to build and operate public works. It is becoming more or less common to search for one who has had previous experience and to appoint the best qualified among those available, even though he comes from a distant state or municipality and has not sought the position through "pull."

This is a sign of better things in the public service, and is in large measure due to the recognized need for the application of the principles of science and engineering which have made remarkable advance in the past generation, are making such strides at the present time and promise so much for the future.

Mr. Frank E. Winsor, Chief Engineer, Metropolitan Water Board of Boston, spoke on metering water. The public cannot be forced to use meters if they object. Some cities with enormous consumption of water per person use no meters. Other cities with the same consumption use meters. It is impossible to predict whether the consumption per capita will increase or decrease with the installation of meters.

* * *

Mr. Saville of the Hartford Water Commission gave the following paper on the requirements of sound water supply financing:

ALL business endeavor, to succeed, must be founded upon a sound financial basis, and the business of furnishing water is no exception to this proposition.

The essentials of both privately and publicly operated utilities are the same, the apparent differences are merely branches as it were, from a single stem.

The owners of the private utility are the stockholders, who take profits on their investment through dividends; the consumers are the stockholders in the municipally owned plant and take their profit in rate adjustment and other common advantages.

In properly run water supply sys-

tems, however, whether publicly or privately controlled, the basic financial and operating methods may be considered as practically the same, and, except as noted hereafter, no distinction will be made in this discussion.

In the first place, it should go without saying, that proper bookkeeping and accounting methods must prevail; to get efficient results, a proper income is the first requisite; to get this, need must be shown; to show the need, facts are required, and these facts can be had only from clear financial statements.

Best production can be had only through comparison with similar work elsewhere and to get this, a uniform system of accounting under some general supervision is most desirable.

Such control is found under the Public Utilities Commissions or similar bodies now established in most, if not all, of the States.

How far such bodies should exercise control or regulation over publicly owned utilities is a matter for local determination, but it seems desirable in the interests of the whole that some liaison authority should be recognized in order that no injustice may be done to any.

The first problem that presents itself is the matter of RATES and RATE BASE:—

The Wisconsin Supreme Court has said: "Having due regard for public interest, it is a matter of policy that the rate should be large enough to earn a return which will attract capital to the utility field; which will readily permit expansion and extension of the utility service and keep it in a high state of efficiency; which will attract to the utility field the best type of sound, economical, aggressive managerial ability, and in other ways stimulate productive activity which will be for the benefit of the public and incidentally for the benefit of the investor. Capital is not attracted to an enterprise which must constantly travel near the financial dead-line which divides prosperity from bankruptcy and the creative genius of managers is not stimulated by deficits."

The amount of return which a public service corporation receives depends upon the rate base, which is the value of the investment upon which the utility is entitled to earn a return and upon which the rate of return is allowed.

This rate base must be reasonable and a fundamental requisite is that

Mr. Saville's Paper
(Continued on page 86)

"Sewer and Sewerage Disposal Problems of a City" is the title of the second paper of Mr. H. P. Eddy. The paper follows:

SEWERAGE systems, being out of sight, are usually out of mind, except among those entrusted with their construction, operation and maintenance. The lack of anything above ground to show to the taxpayer makes sewerage work in a city one of its least appreciated activities.

At the founding of the United States the living conditions of the people were extremely simple. Plumbing was practically unknown. Few public water supplies and no public sewerage systems existed and primitive methods for the removal and disposal of household wastes prevailed.

The development of sewerage systems has been coincident and in a measure commensurate with the growth of cities. With the introduction of public water supplies and the gradual increase in plumbing, the need for prompt and inoffensive removal of liquid wastes became acute. Prior to this, however, drains for the control of surface water were needed in many places.

At first surface water drains were built by individuals, or by groups of persons. Often these drains were utilized later for carrying liquid wastes. In Boston it was not until 1823 that the city took over the maintenance of the then existing drains and the building of new ones. Even then only liquid wastes were allowed, the admission of solid matters being prohibited until about 1850. In Baltimore this prohibition continued until 1911, when the new comprehensive system of sewers built after the great fire, was put into operation.

The early drains and sewers were built without regard to the needs of the community as a whole and did not follow any technical basis of design. In many cases slopes were inadequate and in some instances the sewers pitched the wrong way. The first application of engineering skill to the design of sewers in this country was in Brooklyn about 1857. These sewers served as models for many years thereafter.

Sewers vary greatly in size according to the extent and condition of the areas served by them. For the liquid wastes relatively small pipes are required, but for carrying away the storm water very large structures are often necessary. The determination of economical arrangement, appropriate sizes, justifiable depths and many other important features of sewer systems, requires experience, skill and good judgment.

Often cities are confronted with the necessity of providing new sewers to relieve those which have become outgrown by the increase in tributary population and development of drainage areas, and to replace sewers whose physical condition has deteriorated to such an extent that they cannot longer be continued in use. Neither of these conditions may have resulted from lack of skill or judgment, but often this has been the case. Under present municipal conditions the building of sewers involves large expenditures and is is therefore important that the greatest skill be applied to their design. It is not an exaggeration to assume on the average that every dollar legitimately spent in refinement of design will result in a saving in construction cost of ten times as much.

The rapid growth of cities and the present marked tendency for the residents to spread out into suburban districts are placing a heavier burden of expense than formerly upon cities, in order to provide adequately for a somewhat sparse and scattered population. This has led to the adoption of temporary measures such as the building of sewers of capacity sufficient only to meet the estimated requirements for a few years, with a view to building auxiliary or relief lines as required in the future. Obviously most careful planning is necessary to secure ultimate economy.

For several reasons American practice has tended toward the separation of sewerage and storm drainage. In many cases the sewers, which are small and relatively inexpensive, have been built before the storm water drains. While this has resulted in reduced first cost it has encouraged the serious misuse of sewers, to which have been connected many roofs and surface drains. In time of storm the small separate sewers have been seriously overloaded, causing the sewerage to set back into basements, and in some cases to overflow the manholes and run off over the surface of the ground. Furthermore, there are many instances of the discharge of sewerage into storm water drains, which has resulted in the pollution of water courses which were not intended to receive sewerage.

These objectionable conditions have often been due to lack of training on the part of officials and employees, who have not appreciated the importance of proper regulations or of en-

Mr. Eddy's Paper
(Continued on page 82)

Administration of Street Cleaning and Disposal of Community Waste

Prof. Bassett of The Massachusetts Institute of Technology acted as leader at the session on "Administration of Street Cleaning and Disposal of Community Waste." He commented on the importance of this phase of civic activity and emphasized the fact that this work required real engineering for successful service. He then introduced Mr. Elmer C. Goodwin, Chief Engineer, Dept. of Street Cleaning of the City of New York. Mr. Goodwin showed that:

"Snowfalls became a matter of concern with the advent of mechanical transportation. Railroad Companies were the pioneers in the field of snow fighting and snow removal. The street surface railways were the next to enter this field of endeavor.

The introduction and rapid increase in the use of the automobile vehicle in city streets, brought home to the Town, City and State official, for immediate solution, the problem of snow fighting and snow removal. Snow removal based on definite programs has had an indefinite growth, but until the use of powerful motor propelled vehicles, it did not attract countrywide recognition, nor was there such a uniformity of procedure as is in vogue at the present time.

The problem which confronts the City official is dependent upon several factors all closely correlated. The more important of these are, traffic density, importance of the streets or locality to be handled, equipment and force with which the work is to be done, the amount of money available, the method of procedure to obtain the best results and public cooperation.

In a city such as New York, where the density of population is great, traffic is congested and millions of people have to be transported at least twice a day, the snow problem is a serious one.

As in all emergency conditions, concentrated action must be maintained by forces hastily gathered together for short periods of time.

There must, therefore, be a nucleus of trained individuals to plan, carry on and direct the work done by the greater force of untrained temporary employees.

Speed is the essential factor in snow removal in any large city. Traffic is the overshadowing factor in preventing speed in the removal of snow.

The temporary paralysis of traffic caused by snowbound vehicles creates a grave fire hazard which may result in the serious loss of life and property.

The slightest delay in the removal of snow from the main arteries of travel results in serious congestions which are very costly to business interests and the general public. It has been estimated by the Merchants' Association of the City of New York, that a tie-up of traffic resulting from a heavy snow-storm, costs the business interests of the City of New York approximately five million dollars per day.

It is absolutely imperative that a trained force and proper equipment to prevent such a condition be set in motion immediately, when necessary, to keep the roadways clear, and by keeping abreast of the storm, making speed an essential factor, prevent the condition responsible for the congestion of traffic.

In many of the cities of the east, which were not planned but like Topsy, "just growed," the business sections are located in the area first settled and where the streets and avenues are too narrow for traffic under normal conditions. Snow must be plowed to the sides and piled in such sections and the return of the normal flow of traffic depends upon the rapid removal of the piled snow.

Generally speaking the sections requiring immediate attention are the business sections, the wholesale districts, the railroad terminals and through highways. In these areas is found the heavy, bulky, slow-moving traffic in and outbound, and the transportation of foodstuffs or other perishable commodities and that portion of the public having missions in and about town.

Years of experience show that the equipment to be used, in handling the emergency condition resulting from a heavy snowfall, is the most important factor in affecting speedy and economical relief.

Because most cities work on a small financial margin and in the interests of public economy, the following general rule may be formulated—wherever possible, equipment should be of a type useful all the year round and adaptable to snow work. The heavy duty motor dump truck and the street flusher fitted to be equipped with auto front push plows are examples of equipment which comply with this rule.

Equipment used exclusively for snow has been developed to a greater degree of practicability within the past five years than during any previous period. In some cities its purchase is recommended only when it can be shown that labor is not available or dependable, or is more expensive, or when the demands of the public make it imperative.

The trouble experienced with most of the so-called special snow equipment—and it is not yet a thing of the past—is that it is an adaptation for snow purposes of some unit useful in the general contracting, industrial or other field of endeavor. It has, perhaps, been redesigned by an office engineer with no experience whatever in the handling of snow, a material of no fixed characteristics, whose physical state will often change overnight.

At the same time, it is a well recognized fact that there is small profit for any manufacturer in the design, development and manufacture of equipment requiring such rugged characteristics as is needed in snow handling machinery. This is true where the adaptations appearing to answer the purpose may undersell the unit and make the point of saturation for the factory output too small for anyone profitably to undertake the proposition.

Special snow equipment manufactured from a specification prepared by those competent to specify what is required has been purchased only by New York City in sufficient volume to warrant a manufacturer undertaking this task.

They are as anxious as any other body of officials to make improvements in their methods or equipment which can be justified. At this point it might be said that the New York authorities do not feel that snow and its attendant problems have been completely solved.

In New York any manufacturer or enthusiastic inventor may ask the Commissioner of Street Cleaning for permission to demonstrate his device under practical working conditions during a snow season. The unit is assigned to a district where it operates under the supervision of the District Superintendent in its daily routine. Observed by a member of the Engineering Bureau detailed report is made of the performance of the unit under the varying conditions of work.

Where large fleets of trucks and many units of special equipment are in use, it is necessary to have an auxiliary fleet of supply trucks, service trucks and wrecker trucks.

In large cities which of necessity cover areas of considerable extent, all equipment should be housed at stations convenient to their assigned position. This is an essential to proper supervision of all branches of the service.

Experience in New York has taught

that emergency or slight repairs and adjustments may be more readily made at the local housing station and all major repairs and overhauling best done at a Central Repair Shop. Further, the program should be prepared so that the whole equipment is in readiness at the approach of winter. Furthermore, the operators of its equipment should not be permitted to make repairs or adjustments of any nature whatever. All repairs and adjustments should be made by the mechanics, either in the field, at the housing station or at the repair shops. Oiling and greasing of the equipment should be done by specially trained employees to keep the various units in proper condition. The operator should only be responsible for the proper supply of gas and water.

In New York, among the equipment which is available for service all year round, are the two-ton, five-ton, and seven and one-half ton trucks with body capacities varying from three cubic yards to fourteen cubic yards. In the warmer seasons of the year they are used for hauling ashes, garbage and rubbish. During the snow removal periods they are used for snow plow work and snow hauling.

In addition to these units the city owns 167 power flusher units of 1200 and 1500 gallon tank capacity mounted on five and seven ton chassis. In the warmer months they are used for flushing the street, and during the snow period they have cradles built within the tanks, and are weighted with granite block, and with snow plows attached to the front ends they are assigned to snow plow work only.

The special snow equipment consists of 20 rotary snow brooms, 41 snow loaders of the conveyor type of various makes, 2 small four-wheeled tractors with small snow plow equipment for cleaning the crosswalks and about 1500 auto front push plows.

Many city officials experience great difficulty in obtaining sufficient equipment to accomplish the task which the public expects them to do.

In New York plans for new equipment are completed shortly after the close of the snow season, money is appropriated, specifications are prepared and advertised, the new equipment is manufactured under city inspection, and delivered in time for the proper instruction of employees in its operation and is ready for the following season.

The volume of equipment may be made more or less variable if privately owned trucks of the conventional type equipped with sideboards are previously listed for hiring at the prevailing rate in emergency periods.

With the purpose in mind of eliminating claims for damages to trucks and for better supervision, it is better that the more strenuous work of snow plowing be assigned to municipally owned equipment.

Upon the proper use and handling of the equipment depends not only the successful prosecution of the work, but also the life of the equipment.

With the advent of modern mechanical equipment, it has become necessary to have a force so trained that they will correctly and intelligently handle the high priced and finely adjusted pieces of equipment placed at their disposal by the municipality for proper operation in their work. More necessary than this training of the men handling equipment there is required for the proper supervision of all the work, a body of superior officers of keen wit, clear intelligence, quick decision, and commanding personality.

A position of general excellence of the whole force is only attained through constant instruction by competent teachers. The classes should be divided, the supervising force receiving instruction apart from their subordinates. With the advent of each new type of equipment men selected by the superior officers should be instructed in the use and operation of the equipment, and if duly diligent and successful in tests of their knowledge and ability should receive permanent assignment to the unit.

It is suggested that as an inducement to the development of the operator's interest in and care of the machine, that when special snow machinery is to be used a temporary advance in the rate of pay be granted to the operator. This will produce results of great benefit to the municipality.

For the emergency period of Snow Removal, sweepers should be trained as foremen of the emergency labor which is hired for this work. The sweeper and his gang should be assigned to the locality in which he performs his daily task under normal conditions. In this manner very efficient work may be obtained from the emergency crew.

In New York it has been found that hand labor is non-productive to about forty per cent of the time, due partly to the constant stream of passing vehicles in the streets at all times, and partly to the type of labor which answers the snow call.

With this in mind the department is striving for the perfection of mechanical appliances as a substitute for hand labor and it is safe to predict that within a few years all department work made necessary by the fall of snow, will be handled mechanically.

The emergency labor in New York is recruited principally through advertising mediums, in a campaign begun in October. The department equipment and the section stations are placarded with signs notifying all of the opportunity for employment during the snow periods. Advertising by means of slides in the motion picture theatres in districts in which the laboring man lives is also done. In this manner from ten thousand to eighteen thousand men are recruited for each storm.

Where the contract system is used in addition to municipal forces, the contractor should be bound by a properly executed contract specifying in detail the work he is to perform and the manner in which he is to be paid. The work of the municipality should be so arranged as not to overlap nor interfere with the work of the contractor.

Snow removal cost data varies. A five inch storm in New York City followed by rain and thaw may be removed at a cost of $150,000.00, while a three inch storm with freezing weather and sleet, which would cover the streets with ice, followed by low temperatures, may cost $700,000.00.

The average cost of snow removal in the boroughs of Manhattan, Brooklyn and The Bronx approximates three and one-half million dollars yearly. The average yearly snowfall approximates twenty-eight inches.

An idea of the change in attitude of officialdom, which in turn surely reflects public opinion, may be obtained from the following:

During Mayor Hugh Grant's administration in New York City, in the years 1889-1892, the Commissioner of Street Cleaning requested an appropriation of $25,000.00 for snow removal in New York City. He was put out of the Mayor's office with the Mayor quoted as saying "Do you want us all indicted?"

During the season of 1925-1926, as the expenditure approached the $5,000,000.00 mark, Commissioner Taylor called at Mayor Walker's office and told him he thought there should be more money appropriated for snow. Like all municipalities with big projects under way for subway building, additional water supply, new schools, etc., money was not any too plentiful. The reply of the Mayor was very apt.

MR. GOODWIN'S PAPER

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What Massachusetts Needs In Public Health

Professor S. C. Prescott of the Institute presided at this round table. In his opening remarks he pointed out Massachusetts' leadership in public health service in the past and the necessity of acquiring a highly trained personnel and of educating the people along public health lines to assure her supremacy in the future. He gave a hasty review of Massachusetts' population statistics to show that growing density raised new public health problems. For example, the population is so dense in rural communities that waste disposal problems are becoming even as acute as the urban problems. He also spoke of the state's water supply problem.

Dr. George H. Bigelow spoke on "The needs as seen by the State Department of Health." Dr. Bigelow discussed three main needs. The first was that of having a more centralized state government in order to gain greater uniformity of public health legislation. He gave examples of the state's lack of uniformity in regard to this matter by citing several different guarantee laws. These laws include several quality standards of milk, the institutionizing of tuberculosis patients, and school legislation in regard to vaccinations. The need of adequate appropriations and of acquiring a trained personnel were discussed also. Dr. Francis X. Mahoney gave a review of public health needs as seen by a City Health Officer.

He emphasized the need of educating public opinion along public health lines. Prevention of disease is more important than the caring of disease. He also, was of the opinion that the state and municipalities lacked uniformity on health legislation.

Dr. Milton J. Rosenau of the Harvard Medical School explained what diseases can be eliminated by preventive methods. Contrary to conditions several years ago the cities have ceased to be more unhealthy places to live than the great majority of rural sections. The rural communities of Massachusetts are becoming so densely populated that waste disposal problems are as acute as they were in cities of forty years ago. Dr. Rosenau went on to say that disease is controllable but cannot be eliminated altogether. His final list of controllable diseases included all the milk born diseases, also smallpox, rabies, diphtheria and scarlet fever, and above all the venereal diseases.

Miss Frances Perkins, of the New York State Department of Labor gave a paper on the New York State's experience with preventive hygiene in industry. In her opening remarks she made it clear that ever advancing and changing industry needs different preventive hygiene that can only be determined by technically trained personnel. The industry under official guidance must choose for itself its own preventive measures. She suggested that the best method of educating the common workers in matters of preventive hygiene is thru the labor leaders. They should be educated in such matters first.

The last paper was given by Dr. George M. Kline, of the State Department of Mental Disease. He showed that it is still possible to reduce mental diseases by more intensive application of methods that have already been used. Mental diseases due to venereal diseases and alcohol most certainly can be reduced.

In the brief discussion, Miss Johnson of the State Department of Health answered a question in regard to preventive hygiene in the industries of Massachusetts. There is no medical expert giving his full time to this. All asistance has come from private industries and individuals. Miss Johnson recommended that a medical expert be appointed for such a position.

* * *

COMMUNITY PLANNING AND TRAFFIC REGULATION

"HOW can a maximum use of our highways be secured with safety? What changes in practice or regulation can be made by the highway administrator which will enable you and me and the other motor users to drive comfortably and without constant interruption when we are on the road at moments of peak travel?

"What steps can be taken to facilitate the constantly growing movement of commodities over the highway out of large centers of population?

"How can we bring the development of rural highways into closer relationship with the transportation needs of the farmer?"

These are some of the questions stated recently from the motor user's point of view by the Chairman of the Highway Committee of the National Automobile Chamber of Commerce.

These questions in themselves are important enough and baffling enough to hold our attention; but there are others even more important and far more baffling; and also, there are points of view to be considered quite other than those of the user of the motor vehicle. Back of all these problems of traffic are the fundamental issues involved in city planning itself, and in metropolitan and regional planning; and furthermore, in the public control of the use of land and of the bulk of buildings—a control which we usually call zoning. As stated recently by the Regional Planning Federation of the Philadelphia Tri-State District, "We'll soon be made to understand that the real problem of dealing with a city like New York or any other city is not a problem of saying that you shall not park your car in front of a certain building; it is not a problem of saying that you will convert a street into a one-way street; it is not a problem of regulating traffic; but it is a problem of planning cities comprehensively over wide areas, comprehensively in regard to their functions, for the purposes for which they exist."

The program at this session of the Public Service Institute provides for a discussion of the broad subject of "Community Planning and Traffic Regulation," and from two points of view:

First, the problem of urban street planning. This topic, properly conceived, carries with it the requirements of the regional survey and of regional planning, which on account of their character and magnitude require periods of years for the formulating and carrying out of fundamental and costly changes based upon careful study and investigation.

The other topic is traffic regulation, which deals directly with what can be done more or less immediately to relieve or ameliorate the existing situation; for a city is an active, living organism, and remedies of some sort, even though they may not be thoroughgoing, permanent nor satisfactory must be applied without unnecessary delay. Those officials who are struggling with this phase of the subject deserve our heartiest cooperation for the ingenuity and resourcefulness they have shown.

While there are broad problems common to all cities that may be stated with reference to the science and art of planning urban and rural communities and their relationship to each other, the problem of every city or region is unique, and must be examined carefully with reference to all of the distinctive and peculiar local conditions. The evidence of all great programs, so far as financing goes, is clear that it does not involve the cities in extra expense. Great sums must be spent in any case. The difference is that under a good plan the money

is spent economically and to permanent advantage.

The most experienced engineers and city planners are of the opinion, I believe, that there is no such thing as a permanent city plan for the active, progressive and growing city, and that the congestion problem must be considered as ever present, and as taking on a somewhat new character from day to day. Nevertheless, great advantages will follow from more thoroughgoing methods than those usually employed. Some of the principal suggestions for the improvement of conditions which have been presented at recent city planning conferences are the following:

The improvement of existing streets through the removal of obstructions, the widening of roadways where practicable, and the provision of easy curves at intersections.

The introduction of by-passes to enable through traffic to avoid congested centers.

The separation of grades at street intersections, where this can be effected without undue property costs.

The construction of elevated express streets along waterfronts or elsewhere where they can be introduced without serious disadvantages.

The introduction of sidewalk arcades with a corresponding widening in the roadway.

The cutting through of new arterial streets where additional facilities can be obtained by no other method.

* * *

STREETS in cities have three main functions, namely to provide:—

1. Rights of way for traffic emerging from points of origin and seeking points of destination, beyond them.

2. Access to and from all abutting buildings for all purposes of industry, business and residence.

3. Public reservations or easements for serving buildings with water, gas, electricity, policing, drainage, and other purposes necessary for health and safety.

Most of the efforts made to solve the urban traffic problem relate primarily to the first function and seldom recognize, or at least give proper emphasis to, the second and third functions of the city street.

Until we get a proper perspective of all the problems of city growth and their relations we will never solve the traffic problem. For instance, no proposals for building new streets, or widening existing streets or regulating traffic will ever be more than palliatives—unless they are part of a general plan in which provision is made for restricting uses, heights and densities of building and for increasing the areas of open spaces required for recreation and other social uses.

In some European cities, notably in Germany and Sweden, specialists in city planning are attached to the personnel of city administrations. These specialists concentrate their attention on the problems of the city as a growing organism and engage in continuous study of the architectural, engineering, economic and sociological phases of urban growth. In America, as a rule, we do not regard the trained city planner as a person whose continuous advice and guidance is needed by the city. We employ him, sporadically, as a consultant when we get into difficulties. We allow evils to become established and ask him to cure them, instead of having him constantly engaged in the work of prevention. Having failed to employ him when he can be of real service to prevent or arrest congestion, we blame him because he cannot remove congestion.

What I have to say on the specific problem of urban street planning is therefore subject to the premises, first that street planning must be dealt with as part of a general and comprehensive city plan if any effective results are to be obtained, and second that every city should have a permanent city planning department adequately equipped with funds and a trained personnel.

We have to get communities to realize that whatever is done to plan streets in advance of development, to widen streets in areas already built upon, and generally to increase the capacity of the traffic ways of the community, will not in themselves remove the causes of congestion or prevent its possible occurrence or recurrence in the future.

Plans have been made for the street system of entirely new cities with extreme widths of street, without preventing the growth of the same evils of congestion that we find in old unplanned urban areas. In existing cities streets have been widened and congestion temporarily relieved without preventing the recurrence of the same conditions after a short period of time.

Unless the plan of the street system is accompanied by adequate regulation of the uses and character of development of the buildings which abut upon the streets, urban street planning will be of little benefit to the community. Until the American city is prepared to boldly face the problem of adjusting the building uses, densities, and heights to the street space, until it recognizes the need for balancing building bulks and the open areas required for circulation, light, air and recreation, there can be no adequate solution to be found for traffic congestion, with all its deplorable consequences.

Any program for construction of new highways or improvement of surfaces of existing highways should be based on the comprehensive plan. A state or city highway plan is not a comprehensive plan, as it relates only to one feature in the development of land. Improvements made from this limited point of view are creating new evils as great as those which the improvements were intended to remove. We should plan first—not merely the alignment, grade and intersections of highways—but the utilization and density of building on adjacent land—before we improve the surfaces.

Every street in a city should be considered in relation to the building development on the land it serves. It should be planned and constructed to serve the purpose for which it exists. At present we standardize the street system as if every street had to serve the same purpose. This is both wasteful and inefficient. It is one of the main causes of congestion because we spend too much money in the construction of wider pavements than are necessary in 75 per cent of the streets, and therefore we have insufficient funds to devote to the improvement and extension of the arterial system of highways.

One of the recent traffic and thoroughfare plans that has been made has received unusual favor from the city for which it has been prepared. The Thorofare Plan of Providence, prepared by Mr. Robert Whitten, as far as it represents a physical layout of a projected street system, is an unusually good pattern.

If Providence has the courage to carry out the constructive urban street planning program it has adopted and follows up the studies it has already made with a general city, or regional plan, designed to coordinate its zoning and thoroughfare plans with its general transportation facilities, its harbors, its industrial growth, its park systems, its civic centers, its markets, and its relations to neighboring communities, it will provide perhaps the leading example of how the problem of urban street planning can be solved.

Our regional studies in New York show that it is essential to deal with wide areas surrounding cities so that the needs of circulation can be adequately met within the cities. We find that improvements of the street pattern if properly conceived and

planned yield revenues to the community and owners of property far in excess of their cost. Where congestion exists it is not a necessity due to lack of space; it is the result of artificial forces that selfishly promote the wrong use of space. The greatest need of the New York Region as of all other great urban regions is to secure a better balanced development and more even pattern of growth, so that land shall be neither overloaded nor underloaded with buildings; and so that the urban street system shall be part of a general design which deals with all the related elements and functions that enter into the structure of the urban community.

The inter-relation between buildings and the street system is illustrated by what has happened in Manhattan in the last one hundred years. The Plan of 1811 cannot be criticized because of having made inadequate provision for traffic. Even with the coming of the automobile it would have provided ample space for all purposes had New York placed proper restrictions on the uses, heights and densities of buildings, or widened the streets to adapt them to the greater building bulks that have come into existence. Had private owners been required to set back their buildings as they raised their height, and, in the case of loft buildings, to provide space on their own property for loading and unloading vehicles, there would probably have been no serious traffic problem in Manhattan today.

Mr. Allen's remarks upon the place of the engineer in our modern era are well worth quoting:

"I believe the best safeguard to any profession is an exceedingly high standard in personnel. If the work of the civil engineer has been insufficiently recognized, I believe the condition may be remedied only by the civil engineer himself through a course of action which should be apparent upon a more careful scrutiny of his responsibilities, a scrutiny which, I think should convince him that he himself has not taken his profession seriously enough.

Civil engineering is not ranked nor equalled by any other profession. The study necessary to properly qualify in it gives breadth of vision, and practice in it gives stimulating contact with every other profession. The part played by the engineer in the advancement of our civilization is paramount. It is his part to clear the way and carry forward those activities which give our advancement concrete form. His success in performing this work depends upon the training he receives to fit him for it, upon his vision of his responsibilities and his willingness and capacity for driving himself into a condition of proper fitness."

Harold S. Buttenheim, Editor of "The American City" said that to make a sane program of city development popular is the most important and most difficult task in the public service. In order to achieve this purpose, the psychologist must be called upon to devise means of influencing public opinion, and to create a spirit of civic interest which will bring about more permanently beneficial results. The entrance into the public service of influential and leading public-spirited citizens to aid in city planning, zoning systems, and traffic regulation, will do much to promote constructive programs in our towns and cities. The daily and weekly press and the courses in civics and citizenship in the schools can do much to develop a saner attitude toward municipal growth.

Mr. T. Warren Allen, Chief, Division of Control, of the Bureau of Public Roads, spoke upon "Personnel Training in a Government Bureau." The organization of the Bureau was outlined, and its function for the supervision of Federal expenditures made in cooperation with the states for a Federal system of highways was explained.

A definite program has been established to insure an efficient personnel among the engineers engaged in the work of the Bureau. In the spring, leading educational institutions are visited, and in each one man is selected from the Junior Class for summer work in highway construction unit cost study. The men have an opportunity in this way to obtain some idea of the work of the Bureau, and are able to pursue the studies of their final year with the advantage of practical experience behind them. On graduation they are well prepared to hold responsible junior positions with the anticipation of rapid advancement.

The field of highway engineering as it exists today and as it may be in the future was developed at great length, and the point was stressed that altho many advances have been made, there is still a crying need for waste elimination. Present day methods are little, if any, in excess of 50 per cent efficiency.

THE UNIVERSITY AND THE PUBLIC SERVICE

THE subject for our discussion this afternoon is "The University and the Public Service." The largest public service that a University can render is to turn out young men and young women who have the kind of training that will make them the best sort of public servants. The reason why a University has a right to expect benefactions from those who are financially able is because the University makes a distinct contribution to society in training the rising generation. Ministers, school teachers, physicians, lawyers, engineers, leaders in industry and in business,—all of these are needed in any rightly ordered society. By training young men and young women in the truth, by acquainting them with knowledge accumulated in different branches of study, by the rigorous disciplining of the mind, by the development of personality,—in all these ways the University renders an incalculable public service.

But there is an essential that is often overlooked in formal education, and that is the development of the right kind of character. We must send out doctors and lawyers and preachers and business men and leaders in industry and engineers who are not only smart, but who are also good. Moral soundness outshines mere cleverness as the sun outshines an electric light.

We should send out a stream of graduates who are in themselves socially cleansing and life-giving. I like to think of the University as a great reservoir of life-giving water, sometimes distributing its flow over the plains of humanity through a system of pipes and sluices called churches and schools and courts and hospitals, and sometimes there is a seepage and flow of the spirit of the University through the fissures and conduits of society which is beyond charting or measurement.

We know that to train future citizens for public service, we must train them in public service. Therefore, the city becomes our laboratory for the training of our students in every form of service which the city needs. This is true education. Education is a matter of adjustment between organism and environment. Life is a series of interactions. Society is a process of human relationships. Education is a development of the individual to meet life situations. Aristotle said accurately: "By doing justice we become just and by doing acts of temperance and courage we become temperate and courageous." The

training *for* democracy is training *in* democracy. Likewise, training *for* initiative, responsibility, freedom, enthusiasm, sacrifice in a great purpose is training *in* those very things. We cannot develop the passion for humanity without making that the controlling spirit and purpose of the University.

Is there any public service today greater, more significant, than the telephone and those forms of communication, such as the radio, that have been developed from the telephone? Let us never forget that the telephone itself is the product of a professor in Boston University. At the time that Alexander Graham Bell made his great invention, he was regularly employed as Professor of Speech in Boston University. He made his experiments in the University, and was dependent upon the University for his livelihood during his investigations, and he made the invention not as an accident, but directly in line with his course in the University on the "Mechanism of Speech." I do not know of any better illustration on the subject of the afternoon than the fact that this wonderful and, as we view it now, indispensable means of communication was invented by a Professor in Boston University.

If any further illustration is needed on the subject for this afternoon, let it be noted that this Public Service Institute has assembled a rather remarkable group of authorities in various fields of human thought to present their viewpoints to us.

* * *

THE TAX PAYER AND THE PUBLIC SERVICE

Mr. Roland W. Boyden, the United States Unofficial Delegate to the Reparations Commission, opened the meeting. He then introduced the first speaker, Mr. Charles P. Howard of the State Commission on Administration and Finance, who spoke on the Efforts Massachusetts has made to cut taxation by the formation of the Commissions. He opened his talk by comparing wages and taxes in the whole country for the past ten years. According to Mr. Howard the cost of government in Massachusetts is higher than many other states, even though the attempts to cut it have been fairly successful. The state, however, does do more for its citizens than any other and while each of the other forty-seven states have increased their tax burdens in the last ten years, Massachusetts has decreased hers. This has been made possible in several ways, first, by the fine cooperation between every department, second, by the adoption of the budget system, third, by the reduction of the number of departments from 101 to 20, thus avoiding duplication of work; fourth, by the utilization of all discounts for prompt payment, and fifth, by the fact that the Commonwealth is issuing no more bonds. An efficiency bureau has been instituted. It is estimated that by use of this alone $330,000 has been saved in printing, $120,000 has been saved in interest, while coal bills have been cut in two by the substitution of coke for anthracite in the state hospitals, asylums and prisons. Since 1919 the state debt has been lowered from $40,000,000 to $16,000,000 and the state taxes have been cut $2,000,000. He also mentioned the huge building program which the state has undertaken—comprising mostly homes and hospitals for the feeble-minded and a jail for short-term offenders.

Mr. Fred Telford, the director of the Bureau of Public Personnel Administration, spoke on the growth of the public service and showed that it might easily become a menace. "A democracy is inefficient because it starts things which it is unable to control." Mr. Telford advances the theory that as the public service grows relative to the population, the larger it gets the harder it will be to run. It is approaching the danger point already, and the same thing is occurring in the present education policy. It is therefore evident that all such agencies must be controlled and at the same time required to meet a given standard.

The last speaker was Professor Charles A. Beard, former director of the Training School for Public Service. He showed in the main, how everyone gains by paying taxes for the removal of snow, the care of delinquents, and mental defectives. He then showed how incomes and expenditures have varied in the past 100 years.

* * *

SPECIAL PROBLEMS IN THE PUBLIC SERVICE

How to Obtain the Right Personnel

Mr. Eliot Wadsworth, formerly Assistant Secretary of the Treasury, started the discussion on "The Investigating Expert in the Administration of Government," by giving a short address on the difficulty of getting experts to work for the Federal Government at the pay offered.

Mr. Telford was then called upon to speak on the subject: "The Investigating Expert in the Administration of Government." His main topic was the status of the experts engaged in Public Service work compared with the status of experts in other departments of the government. The psychologist, statistician, and personnel expert are not recognized and usually considered as a necessary evil.

Following this, Charles L. Carr, Chairman of the Finance Commission, spoke on the subject "How the Boston Finance Commission Functions." By giving its history, duties, privileges and a resume of the work it has accomplished, he left a clear idea of how this branch of investigating experts functioned.

The Finance Commission of the City of Boston has been unique among municipal institutions. It was created by an act of the Legislature in 1909 and is charged with the duty of investigating any matters relating to appropriations, loans, expenditures, accounts, and methods of administration affecting the City of Boston or the County of Suffolk. Among its employees are counsel, engineers, investigators and the usual clerical force. Power is given to require the attendance and testimony under oath of witnesses and the production of all books, papers, contracts, and documents relating to any matter within the scope of its investigations.

While the commission has no power to enforce its findings or restrain improper or illegal acts of city officials, it has adequate power to investigate and find facts and to make them public. The theory on which it was created is that publicity is the cure of municipal evil. When the voters are in possession of the facts the remedy lies in their own hands and they may have as good a government as they desire.

Five members compose the Commission, but of these only the chairman is paid, and upon him the active responsibility for the work falls. Whenever anything comes to pass requiring special consideration, the chairman orders an investigation, which is usually conducted by the counsel for the Commission. If the results of the investigation warrant it, the reports are made public, and in questions of great interest, public hearings are often held.

It has been found that in the investigations, many minor defects are discovered and made right, without the necessity of a formal procedure. Often studies are made of various lines of the municipal services. Among these studies, the work on the Boston School system and the hospital situation are noteworthy. Many thousands of dollars have been saved by checking up on contracts and competitive bids.

In conclusion, it might be said that

the commission deals with facts rather than theories. and that in this way it performs a much needed service for the municipal government. It is unpopular in some quarters, for it is fearless in its investigations and in the publication of its findings. Nevertheless, the commission goes on its way, intending to be free from the effect of partisan politics and to be influenced by neither fear nor favor. Its position as a State commission makes it entirely free from interference by the municipal government, thus insuring its independence.

The leader of Round Table number two, Professor Holcombe, then took the chair and started the discussion on the subject "How to Obtain the Right Personnel." He spoke of Colonel Roosevelt's experience in the Civil Service Commission of New York City. He introduced the next speaker, Charles S. Shaughnessy, who talked on the subject of "How to Obtain the Right Personnel."

Percy Harrison spoke next and gave many examples of how politicians often tried to give a man a job for which he was absolutely unfitted.

Mr. Telford concluded the session by explaining the varying status of the expert administrator or investigator in the public service. While the legal profession has been fully recognized and preference given to its members in governmental positions, many of the other learned occuparions are not as fortunate. This is particularly true in the cases of the newer social sciences, such as psychology, statistics, economics and personnel. At present, wide application of these recent developments is slow to materialize, yet when it does come, it will bring about a far wiser and far more beneficial administration of our public affairs.

* * *

Problems In Public Purchasing

The consensus of opinion in this group was:

1. That an intelligently conceived and directed central purchase plan is a sound and logical method of public purchasing in a Governmental group.

2. That centralized purchase as here used comprises the following steps:

a. Standardization—The selection of a minimum number of proper materials to adequately meet the requirement.

b. Specification—The description in definite terms of the requirement to be met.

c. Purchase—The actual purchasing of the materials described by the Specification.

d. Inspection—Test of deliveries to ensure that the materials purchased meet the specification.

3. That frequent round table discussions such as this in any community would do much to stimulate interest in purchasing as a common problem.

4. That the work of the following organizations offers a source of invaluable information and aid to any group interested in establishing centralized purchase.

a. Bureau of Standards, Washington, D. C.

b. Federal Specification Boards, Dr. George K. Burgess, Bureau of Standards, Washington, D. C.

c. American Engineering Standards Committee, 40 West 39th Street, New York City.

d. American Society for Testing Materials.

Dr. Stratton opened the discussion with a statement of the importance of the buying function in public service and expressed the hope that this meeting was but the forerunner of many similar meetings in numerous communities, to discuss methods of approach in overcoming some of the obstacles which confront the public purchasing official.

Dr. Burgess then outlined the work of the Bureau of Standards and the Federal Specifications Board as aids in the purchase of supplies for the Federal Government. Dr. Burgess emphasized particularly a plan of Certification which is now in the process of development at the Bureau of Standards. This plan embraces, as a first step on the part of small municipalities and other similar consuming groups, the use of standard specifications for the purchase of articles of common use. It then proposes, in order to ensure the delivery of material conforming to the specifications, the utilization of local commercial testing laboratories. A list of such laboratories which are adequately equipped and willing to undertake such tests will be issued by the Bureau of Standards in the near future.

The plan outlined by Dr. Burgess led to a rather general discussion of the problems of completely centralized purchasing of governmental groups. Some disadvantages were pointed out, particularly in the case of the larger cities where some outlying department or station might find itself in a position to purchase minor commodities in the neighborhood more economically and conveniently than by sending its requisitions through the central purchasing department. It was generally appreciated that such situations do exist and commodities which fall into this class, due to some local condition, should not rightly be included in a central purchase plan. It was the consensus of opinion, however, that centralized purchase is a logical and economical method of procurement.

President Stratton suggested that the sense of this meeting concerning Purchasing might well be conveyed to the Civic League and asked that a Committee, comprised of Dr. Burgess as Chairman, Mr. Keyes, Mr. Cronin and Mr. Brush, formulate general recommendations based on the morning's discussion.

* * *

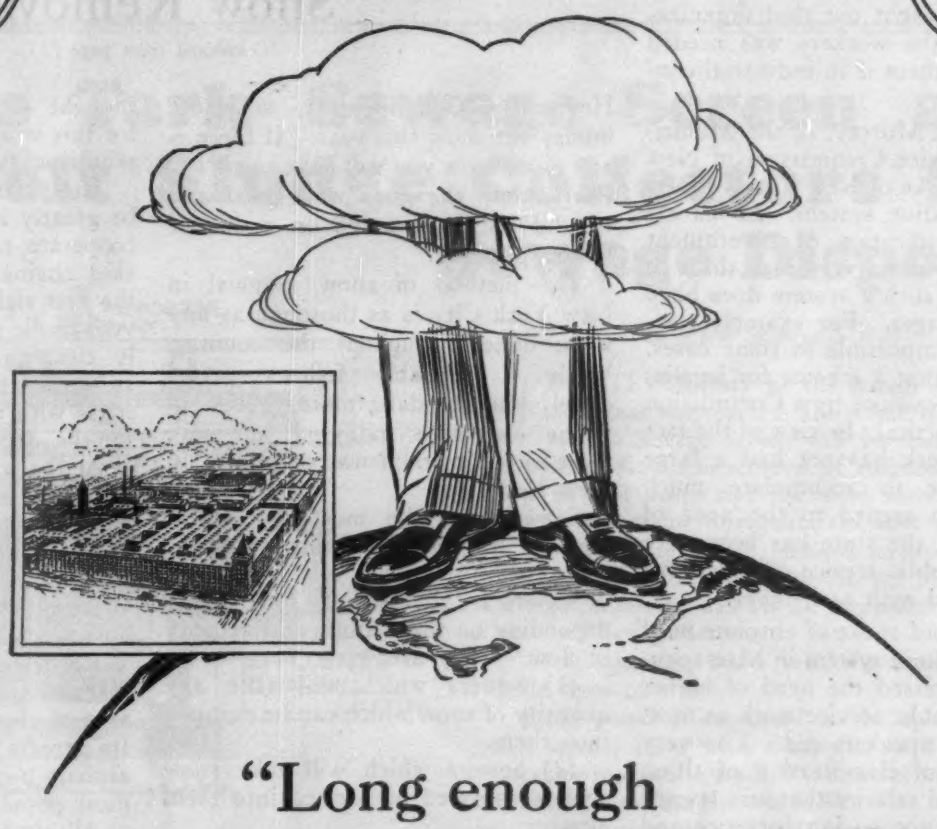
CLASSIFICATION OF POSITIONS ITS SIGNIFICANCE IN THE IMPROVEMENT OF THE PUBLIC SERVICE

The four speakers at this luncheon gave papers on whether a Classification System of Positions and Salaries help to Improve Public Service?

The general opinion was such a classification was one of the most needed additions to Public Service. Professor C. W. Doten, of the Massachusetts Institute of Technology, who presided at the luncheon, spoke of the small salaries public service workers were receiving.

Charles S. Shaughnessy of the Philadelphia Civil Service Commission very strongly believed that a classification system was needed. He felt that such a system would check the creation of superfluous government positions, that it was essential, if competent personnel were to be attracted by the promising career to be found in public service, nor would an employee rating system function without classification, this is the only way to provide for a definite promotion program. He finished his talk by pointing out that most of the large commercial concerns have an employee classification scheme of some sort.

John S. Miller as attorney representing the Commonwealth Service Association spoke on the need from the employee's point of view. He made it clear that a definite statement of policies in a classification of positions in Public Service was much needed. He too thought that the system would raise the employee's morale by pro-



"Long enough to reach the ground"

LINCOLN'S famous answer to the question "How long should a man's legs be?" suggests a similar answer to the question "How large should an industrial organization be?"

Large enough to do its job, of course, which simply means that there's need in this country of ours for both small and big businesses and both can prosper.

The job of providing electrical communication for the country calls for a vast organization backed by vast resources. And that's what the Bell System is.

Here great size has advantages in greater operating efficiency through which its customers benefit, and advantages to those engaged in the industry who find here a wide range of interesting work offering opportunity to men of varied talent.

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Number 66 of a Series

viding the possibility of a career. The point was brought out that organization among the workers was needed the same as there is in industrial concerns.

Thomas C. Murray, of the Municipal Civil Service Commission of New York City spoke of New York's efforts at a classification system. In his experience classification of government positions was not a very easy thing to do, although such a system does have great advantages. For example classification is impossible in some cases. He believed that a scheme for legalizing titles of positions by a Commission was quite practical. In view of the fact that New York has not had a large enough force to accumulate much knowledge in regard to the need of classification, the state has been very lucky that public service officials have not interfered with each other.

Fred Telford spoke of absolute need of a classification system in Massachusetts and stressed the need of higher salaries in public service work as most of the other speakers did. The very fine system of classification of titles, positions, and salaries that was started in 1913 did not go into practice and was never fully completed. A system with some modifications is before the state legislature now but is in danger of being defeated. The opposition comes mostly from disappointed office seekers on grounds that the costs of the system, including raises in salary, would amount to $600,000. The State finance department cannot appropriate the money by an additional burden to the taxpayer. Additional burden to the taxpayer is distinctly against the policy of the existing State government.

In the discussion that followed, the question was asked whether it was better to adopt a classification system by legislation or by order of a government officer. Mr. Telford answered by stating that it was better to adopt it by legislation, if provision was made for any change that might be needed in the future.

Dr. Burgess, of the Bureau of Standards, stated how well a classification system worked in his department of the government. He believed, that it should be more flexible than it would be, should a legislation be needed to improve the classification scheme in the future. Mr. Telford spoke of the bureau of standards not being as much in need of such a system as other public service departments.

Conclusion of Institute

Snow Removal

(Continued from page 71)

He said: "Commissioner, no more money for snow this year. If there is any more snow you will have to eat it." Fortunately the gods were good and we did not have to go on a diet of frozen pudding.

The method of snow removal in New York City is as thorough as any work done throughout the country. While it probably follows pretty closely the standard more or less in vogue elsewhere today, I am sure most of the method was originated in New York.

Sewering is the most economical method for the final disposition of snow.

Sewers are divided into four classes depending on the volume and velocity of flow. They are:

(1) Sewers which will take any quantity of snow which can be dumped into them.

(2) Sewers which will take snow that is shoveled or panned into them slowly.

(3) Sewers which will take panned or shoveled snow only when the flow is augmented by water obtained from nearby hydrants.

(4) Sewers of this class are unavailable for any snow disposal work.

The sewer maintenance crews are assigned in each borough to the work of keeping the sewers clear of obstructions and freely flowing.

For future design, it is recommended that sewers of adequate size be provided, with manholes conveniently spaced on the various thoroughfares which would be adapted to the disposal of snow delivered by plowing and dumping from trucks. In this manner snow could be sewered during the progress of and after the snowfall.

In this connection it is proposed to have direct connections made between the water mains and sewers so that when it becomes necessary to augment the flow of water in the sewer to carry off the snow, water sufficient for this purpose may be readily utilized.

Where waterfront dumping facilities are available they may be used to advantage if the haul is not too long. Areas of open ground if away from habitations may be utilized for snow disposal.

The success of the snow removal work of any municipality depends to a great extent upon cooperation by the general public. All available means should be constantly employed to insure such cooperation, without any thought of placing the responsibility for this work elsewhere than upon the municipality.

The problem of snow removal will be greatly simplified if the public will cooperate to the extent of providing skid chains for all motor vehicles at the first sign of snowfall, so as to prevent traffic congestion, and by promptly cleaning sidewalks and piling the snow at the curb, making a single mass with the snow plowed and piled by the department.

At the conclusion of Mr. Goodwin's talk Mr. Stephen B. Story, Director, of the Rochester Bureau of Municipal Research discussed Street Cleaning and the disposal of Community Wastes in Rochester, N. Y., as follows:

Rochester has a population of 320,000 and spreads over a generally level area of about thirty-four square miles. Its streets are practically all paved, asphalt being the predominating and most popular type.

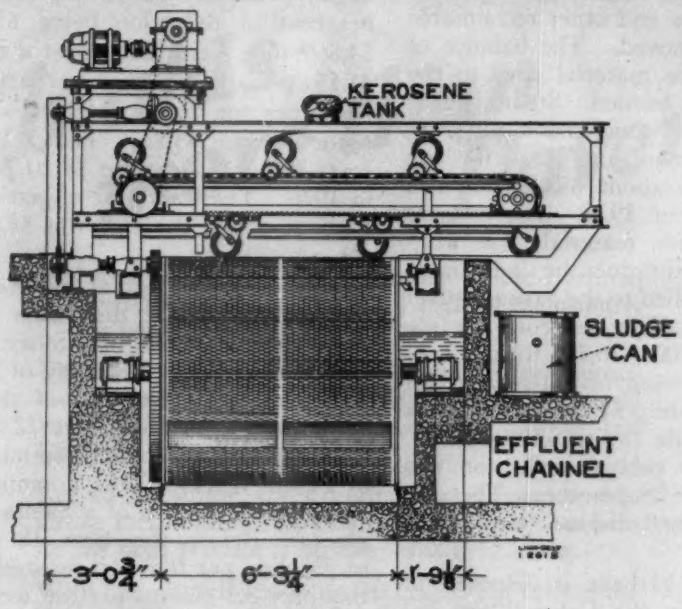
All street cleaning is in the hands of the Department of Public Works. No new or unusual methods are employed. Wherever possible cleaning is done by tank flushers. At first this sort of flushing was confined to asphalt streets because of a fear that the sand cushions under the brick and stone block pavements would be washed out. After experimentation it was found out that the machine flushing had but very little effect in this respect. As a consequence this more rapid and somewhat less expensive method of cleaning has been extended to include streets of this character.

Some of Rochester's business streets are paved with Medina stone blocks which have been in place for thirty years or more. They present a real cleaning problem which is solved by hand flushing three nights a week during the non-freezing seasons. This cleaning at least once a week is extended to include the side walks.

The increasing use of flushers is causing the disappearance of the single patrolman who has a definite area to cover. Pick-up gangs which clean gutters following flushing are more readily supervised and really do a diferent sort of work. Single patrolmen are still found on duty in the sections peopled by foreigners. The inhabitants of these sections throw into the streets more waste of a character not cleaned up by flushers and necessitate

(Continued on page 80)

Use the Tark Sewage Screen and Link-Belt Sludge Collectors for Sewage Disposal



Link-Belt Sludge Collectors

Plain sedimentation with separate sludge digestion is the modern method of sewage treatment.

Link-Belt Sludge Collectors make possible the construction of rectangular tanks, the construction cost of which is low, and the operation of which is efficient.

A recent test conducted by a chemist in the employ of one of our prospective customers, on the tanks of Merchantville, N. J., showed them to be 75% efficient. Suspended solids in the influent were 269 P.P.M.; in the effluent, 63 P.P.M.; the period of detention was 2 hours.

The Link-Belt Sludge Collectors in the final settling tank at the Activated Sludge Plant at Gastonia, N. C., have been in continuous operation for 5 years without a cent being spent for repairs. May we send you Folder No. 849 containing full information?

The Tark Sewage Screen

WHATEVER may be the system of sewage disposal adopted, if a fine screen is used, the Tark Sewage Screen will be found to be the most efficient in removal of suspended solids; low in first cost; and the most economical in operation, because it requires the least attention.

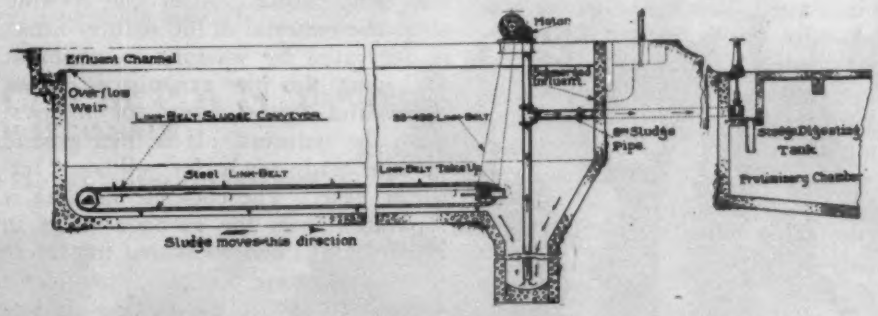
At Keansburg, N. J., drained screenings were removed at the rate of 3000 lbs. per M.G. from sewage containing 250 P.P.M. suspended solids by the Tark Sewage Screen.

After operating for a year, the brushes show little signs of wear.

Little power is consumed in the operation of this screen; those with a capacity of 5 M.G.D. consume practically 1.6 K.W.; those of 18 M.G.D. require approximately 2.6 K.W.

The construction of Tark Screens is of the best materials available. Their appearance is neat. Strength and reliability are outstanding features.

Folder No. 542 containing full information will be mailed upon request.



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LINK-BELT

Sewage Disposal Plant Equipment

Snow Removal

(Continued from page 78)

a retention of the hand cleaning methods. Paper pick-up men are kept on duty during the daytime in the business section.

Rochester, from a street cleaning point of view, is cursed with a snow removal problem. It formerly was necessary only to clean the snow from the business section and from the more important traffic arteries but, in these days when there is an automobile in the garage in back of every third house, we are compelled to keep all of our residence streets plowed and opened for traffic. Rochester does this by equipping all her city owned trucks with blade or "V" plows and in addition contracts with several contractors possessing large trucks to do street plowing. Under the latter arrangement the city supplies the plows and pays for the use of the trucks by the hour.

An unusual practice which we have used in Rochester this year is the prompt removal of the ice, which is formed in the gutters by compaction. An air compressor operating spading tools is used to crack up the ice. It is piled into a windrow in the gutter and loaded into trucks by the Barber-Greene loaders. This method of removal supplanted the method of breaking up the ice by hand picks and loading it into the trucks by hand. The cost by this new method is about two dollars a cubic yard, or roughly half the same removal cost by hand methods.

Rochester dumps her ashes on dumps or fills, incinerates her rubbish and reduces her garbage. Separate collection is thus necessary and is rigorously enforced. The collection and disposal of ashes is in the time honored way. Each year finds a growing scarcity in available dumping grounds within short hauling distances. Thus we may expect from year to year an increase in ash disposal costs due to the necessity for longer hauls.

Our rubbish, paper, cans, glass, etc., is conveyed by truck to a De Cavie incinerator. This incinerator and the garbage disposal plant are located in the gorge of the Genesee river within a very short distance of our business section, in fact, they are within fifteen hundred feet of our tallest office buildings. The rubbish wagons are dumped into receiving bins and the material forked over on to a moving belt.

As the material is moved over to the belt much of the grosser material such as iron beds, mattresses, baby carriages, etc., is sorted out. The belt goes to a sorting room where the bottles, paper, rags and other reclaimable material is removed. The balance of the inflammable material goes to the furnaces and is burned. Steam is generated in this process and is piped to the garbage reduction plant for use there. It cost about $54,000 to run the incinerator in 1926. The revenue from reclaimable materials was $17,000. The credit due the incinerator for steam supplied to the garbage plant was $16,500. The net cost for the year was $20,500. 16,311 tons of rubbish were disposed of. The net cost was approximately $1.25 per ton. This does not include capital charges.

The cost of rubbish collection was $135,049 or $8.28 per ton. The cost for collection and disposal was $10.50 per ton.

Rochester's garbage is disposed of by reduction in the Cobwell process. In this process the green garbage is cooked or dehydrated for the removal of free and combined moisture in a bath of solvent naphtha at a relatively low temperature. After the cooking stage the material in the reducer tanks is degreased by washing in naphtha. Following this the tankage is steam dried and made ready for removal from the reducers. It is then ground up and made ready for sale as a fertilizer base. The cooking naphtha is separated from the garbage water in gravity tanks and recovered for future use. The grease is separated from the solvent by a stilling process and is sold to soap manufacturers.

At no time in the entire reduction cycle are the garbage or vapor from it exposed to the air. As a result there is no obnoxious odor and the process is carried on almost in the business section of the city without creating a nuisance. The cost of reduction may be higher by the Cobwell process than by some of the other methods of disposal but by having the plant located at the hub of our hauling "wheel" we reduce our hauling costs considerably. It is probable that the saving in the latter offsets our increase in reduction costs.

At the present the reduction plant is in most excellent shape. It is running with a consumption of steam, solvent and condenser water less than predicted by the builders. Its mechanical condition is comparable to that of many industrial plants.

The operation cost in 1926 was $255,500. The revenue from the sale of by-products was $191,500. The net cost of reduction being $54,000. 34,869 tons were reduced at a cost of $1.55 per ton. Capital charges of $2.30 per ton bring our total cost of reduction to $3.85. The collection costs for garbage were $4.20 per ton in 1926. The total cost of getting the garbage out of the way was $8.05 per ton.

Two very important points were brought out in the discussion of the paper presented by Mr. Story. The first was about the necessity of having competent administration of the garbage reduction plant. In 1922 an efficient engineer was made Commissioner of Public Works. This Commissioner obtained the service of a Sanitary Engineer. Before this time 18 gallons of gasoline per ton were wasted; after this only 3.5 gallons per ton were lost, and also before this there were 22,000 gallons of water per ton, while after the new men took over the process this was reduced to 2,700 gallons per ton. This and other data was used to prove that competent engineers were absolutely essential for economic management of this system. Another necessary factor for this process is a good market for the by-products. Taking New York City as an example it appears that a garbage reduction plant similar to Rochester's would be profitable to the city. In this case, however, such statistics mean little or nothing because profit would be eaten up by the expense of getting rid of the by-products.

A Bullet Proof Gas Tank has recently been successfully tried out in London. Much of the danger of aerial combat lies in the vulnerability of this part of the plane and the fire which so often follows a crash is usually due to the escaping of the gasoline. The tank is protected by a ½ inch gelatinous coating which is melted and poured over an adhesive varnish. The main disadvantage of the covering is that it weighs one-half pound per square foot of protecting surface, but it is believed that the great amount of life and property which the invention protects will more than overcome this handicap.

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"Concrete — Its Manufacture and Use" is a 210 page treatise on the uses of concrete, including 26 pages of tables of quantities of materials required in concrete paving work. To engineering students, faculty members and others interested we shall gladly send a copy on request.

KOEHRING COMPANY
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***Manufacturers of* Pavers, Mixers—Gasoline Shovels, Cranes and Draglines**

Disposal Problems of a City

(Continued from page 69)

forcing them. In many cases it has been found impracticable to exclude storm water from sewers, because drains had not been constructed and were not available for use. The success of separate systems can only be secured through conscientious, intelligent administration by officials sufficiently well qualified and having enough strength of character and prestige to secure the funds required for the construction of the second line, the sewer or the drain as the case may be, when it shall be needed. Of recent years experience has shown that under existing American municipal conditions it is practically hopeless to secure complete elimination of storm water from separate sewers and of sewerage from storm drains, particularly in the larger cities. As a result there is a tendency toward the more general installation of combined sewers which shall convey both sewerage and storm water.

The early history of municipal sewage disposal is but a recital of discharge into nearby natural water courses. As conditions at and near the outlets became objectionable and intolerable outfalls were constructed to points farther downstream, frequently beyond the boundaries of the city, and where practicable to points where there is available an adequate volume of diluting water in which the polluting matter can be diffused and dissipated. On the coast, as at Boston, outfalls were built to distant points where swift currents would carry away the impurities. Many years ago provision was made for detaining the sewerage of a large portion of Boston in tanks at Moon Island until about flood tide, when it is discharged, the object being to have the sewerage carried directly out of the harbor on the ebb tide.

The treatment of sewerage to secure a measure of purification is of relatively recent origin in this country. One of the first efforts to solve this problem was that of the State Board of Health of Massachusetts which began in 1887 intensive studies to devise and perfect methods of treatment at its experiment station in Lawrence. These researches which are now classic, have formed a valuable contribution to the establishment of the principles involved in the treatment of sewerage and have led to the perfecting of methods both in this country and abroad. The art of sewerage treatment has progressed so that now it is possible by practical methods to secure almost any degree of purification which may be necessary.

Sewerage consists essentially of water, the impurities amounting to only about one-fifth of one pound in 100 pounds, and of the impurities only about one-half is organic matter, the remainder being inert mineral substances. It is the organic matter, which is relatively unstable and susceptible to putrefaction, which causes offensive odor and renders unsightly and objectionable the waters into which the sewerage is discharged.

Bacteria are present in large numbers in sewerage. Some of them may be pathogenic and cause infection if they gain access to the human body through the water supply, shellfish or other raw food. Most of the organisms, however, may be classed as friendly, and function as scavengers, changing the unstable organic matter to stable substances not subject to putrefaction. Some of the processes of putrefaction are based upon the utilization of the living organisms for this purpose.

Sewerage treatment generally is carried out in stages. First, those solids capable of settling are removed by allowing the sewerage to pass slowly through sedimentation tanks. The solids retained in the tanks are then subjected to decomposition or digestion by the organisms, the resulting material being practically free from objectionable odor, in which condition the solids, after being drained or otherwise separated from the excess of water, may be utilized as a low grade fertilizer or for filling waste land.

After removal of the solids the sewerage may be applied to beds of sand or broken stone in carefully regulated doses, and during passage through the bed the remaining organic matter is removed or converted into stable inoffensive substances which will not cause putrefaction in the stream into which it is discharged. There are other methods of accomplishing this, but they all depend upon the action of living organisms.

An older method, though less efficient, is sometimes used, in which the sewerage is treated with chemicals which cause a greater degree of clarification than can be obtained by sedimentation alone, but which do not effect as great a degree of purification as is obtained by the biological processes.

In some cases the treated sewerage is disinfected with liquid chlorine or bleaching powder, to kill any pathogenic organisms which may have lived through the previous treatment and might contaminate a water supply or the water from which shellfish are taken.

It has been shown that the several processes employed in the treatment of sewerage depend upon the principles of several sciences, such as chemistry, bacteriology, and physics. They also involve problems in several branches of the art of engineering. Furthermore, there is a wide divergence in the conditions existing in different cities, and it is not wise to adopt a process, or the major features of a plant for one city simply because they may have served admirable in another.

The sewerage disposal problem of a city may usually be divided into the following major items requiring investigations:

a. The probable composition and condition of the sewerage to be treated.

b. The degree of purification required to meet the needs of the case.

c. The process or combination of processes which will most efficiently and economically provide the necessary degree of purification.

d. The capacities and loadings which should be adopted for the several features of the treatment plant, in order that sewerage of the estimated composition may be purified to the necessary degree.

Enough has been stated to show that the selection of the process and design of a plant for the treatment of the sewerage of a city requires special knowledge and experience. Simply to copy what some other city has done, without proper regard for differences in conditions, is certain to lead to unfortunate results and ill-advised expenditures.

One of the most common examples of municipal mismanagement is found in the field of sewerage works operation. There have been many cases where large sums have been expended upon sewerage treatment projects, but where the appropriations for operation have been grossly inadequate. Often such plants have been put in the charge of employees who have not had the slightest training which would enable them to appreciate, or even to understand, the principles involved in

(Continued on page 92)

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Modern Central Stations

(Continued from page 55)

header; the third is supplied with steam from the 14th stage of the main turbine, and the fourth from the 11th stage of the main turbine.

At high loads the amount of steam from the auxiliaries may be more than the exhaust heater can condense. The excess steam is carried to the 18th stage bleed line through a loaded valve and thence to the 18th stage heater resulting in a decrease in the amount of steam bled from the 18th stage. The pressure in the auxiliary exhaust heater varies with the load from about 10" vacuum at low to 2 lb. gauge at the high loads.

The feedwater heating system is self-regulating and requires no manipulation whatever. The amount of steam bled from the various stages depends on the quantity of feedwater passing through the heaters, inasmuch as each heater acts as a condenser for its steam.

The make up water is introduced into the main condensers for the purpose of de-aeration. It is estimated that it will amount to approximately 2% of the steam produced.

The table below shows the amount of steam absorbed in the heaters, the pressures and temperatures occurring at full load, 60,000 k.w., for certain assumed auxiliary load conditions. It serves to illustrate the progressive heating of the feed water as it passes through the system.

The hotwell pumps provide the necessary head for pumping the water from the hotwells through the ejector condenser and the first stage heater into the second stage heater; from the second stage heater it enters the boiler feed pumps, which pump it through the 3rd and 4th stage heaters into the boilers. The condensate from the stage heaters passes successively from the fourth down to the first, or lowest, pressure heater, being trapped between stages, and from there pumped into the feed water line between the first and second stage heaters. The condensate from the ejector condenser and after cooler is returned to the main condenser.

There are no economizers on the boilers. They are, however, provided with plate type air heaters, which raise the temperature of the air at normal rating, approximately, 390°, the escaping flue gases leaving at approximately 325°.

In the present installation there are 2-60,000 k.w., 1500 r.p.m., three phase, 25 cycle, 11,400 volt, turbo-generators. They are operated with steam at 375 lbs. gauge, 700° F. total temperature. A view of one of the generators is shown in Fig. 2.

They have direct connected exciters 250 volt, 118 k.w. They are each equipped with two external motor driven blowers for supplying the 110,000 cu.ft. of air per minute required for ventilating the generator. This air is circulated within a closed system that contains an air cooler consisting of nests of spiral finned tubes.

The turbine has 20 stages, single flow type, with steam extraction points located at the 11th, 14th and 18th stages.

In addition to the main turbo-generators there are installed 2-500 k.w., 250/125 volt, gear steam turbine driven direct current generators for house service operating on 375 lb. steam, and exhausting at any pressure within the range of 10" of vacuum and 1 lb. gauge back pressure. The speed of the turbine is reduced through a double helical reduction gear to 900 r.p.m. at the generator end. These machines supply power for station lighting, for the boiler coal feeder motors, and for valve control motors.

There is also installed in the mill house a 1,000 k.w. geared turbine driven generator 2300 volt, 3 phase, 25 cycle. This machine operates on 375 lbs. steam and exhausts at 3 lbs. back pressure. The turbine is connected to the generator by means of a double helical reduction gear which reduces the turbine speed of 3,780 r.p.m. to 750 r.p.m. at the generator end. This machine is to be used to furnish part of the power for the mill house motors and its exhaust steam will be used for the coal dryers.

In addition to the above turbo-generators there is in the present installation a 40,000 k.w. frequency changer for converting 60 cycle, 13,800 volt current to 25 cycle, 11,400 volts, or vice versa. This machine serves to tie in the New York Edison 25 cycle system with the United Electric Light and Power Company, and the Brooklyn Edison 60,000 cycle systems. It has directly connected to it a 115 k.w., 250 volt exciter and a 1,600 h.p., 13,800 volt, 3 phase, 60 cycle starting motor.

Each of the main turbo-generators is served with a 45,000 sq. ft. single pass surface condenser.

The hotwell of the condenser is rectangular in shape and has a capacity of 1500 gal. For removing the air and non-condensable vapors from the condenser there are provided two 2 stage twin element steam jet air pumps, with surface inter and after condensers, arranged so that either one or two elements of each pump may be operated as desired, depending upon the air leakage of the unit. They are designed to operate at a pressure of 250 lb. gauge.

The condensate from the hotwell pumps of the main condenser is pumped through the tubes of the inter and after condensers operating in parallel, thus, absorbing all the available heat of the steam used by the pump. The steam from the inter condenser is returned to the main condenser through a water leg and that from the after condenser through a condensate trap to the hotwell of the main condenser.

There are 2-8" noncondensing turbine driving two-impeller hotwell pumps for each main condenser. Each of these pumps has a 12" suction connection and is designed to deliver 1350 gal. of condensate per minute against a total dynamic head, including the vacuum of 135'.

For supplying the circulating water for the condensers each is provided with two 42" double suction bi-rotor pumps having a 48" suction and a normal capacity of 45,000 gal. of water per minute against a total dynamic head of 14.5', 1,000 gal. of this water will be used in the condensers for the turbines driving the circulating pumps. The normal speed of the pumps is 270 r.p.m.

When only one of the pumps is operating on the system it will discharge 57,500 gal. of water per minute against a total dynamic head of 7'. A cast iron exhaust piece rigidly connects the turbine casing

(Continued on page 92)

Load	Heater	Lbs. of Steam to Heaters	Steam Press. lbs. per Sq. In. Absolute	Sat. Steam Temp.	Water Temp.
Main Turbine	Ejector Cond.	1,200	.6	85	80
60,000 K.W.	18th Stage	29,540	5.0	163	158
	Aux. Ex.	39,000	13.1	206	201
	14th Stage	47,200	46.6	277	270
	11th Stage	51,250	127.5	346	339

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DURING the first decade of this quarter century the skyline of New York began to take new form resting on the secure foundations constructed by this organization; then many owners, in other localities, noting the manner of its building, awarded to The Foundation Company contracts for complete construction, so that now the building of superstructures forms a great part of its work.

AS indicative of the service rendered by The Foundation Company over this period of years, these partial lists of repeat contracts have special significance. In one case no less than thirty contracts have been awarded by one owner.

NEW YORK TELEPHONE CO.		UNION GAS AND ELECTRIC CO.		CANADIAN PACIFIC RAILWAY	
Foundations	1916	Foundations	1916	Station Foundations	1909
Foundations	1919	Power House	1918	Righting Elevator	1916
Foundations	1923	Office Building	1923	Locomotive Shops	1920

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Hydro-Electric Developments
Power Houses
Highways
River and Harbor Developments
Bridges and Bridge Piers
Mine Shafts and Tunnels

BUILDERS OF SUPERSTRUCTURES AS WELL AS SUBSTRUCTURES

Requirements of Sound Water Supply Financing

(Continued from page 69)

it will not fluctuate too considerably with changing prices and conditions of operation.

There is no formula or other well defined path by which it is possible to arrive at the true value of any property.

All of the ways, devious and otherwise, that have been proposed by experts and examined by Courts and Commissions, in the last analysis, are useful merely as guides to seasoned judgment, based on common-sense determinations of the presented facts.

In valuation for rate-making, the cost of service is a chief factor, and the return to investors may be stated as the sum of interest on investment and profit on operating expenses capitalized at a "fair return" rate.

What constitutes a fair and reasonable return rate has been said to be "just above the point below which confiscation begins, on the border line between Valuation and Rate Fixing."

It is significant of the close relationship between valuation and rate of return to consider that if a fair rate of 8% is assumed a variation of only one percent either way in rate is equivalent to 12.5% in valuation.

One of the essential elements to be considered in reaching a conclusion as to "fair value" is what may be the future "set" in price levels due to the unprecedented disturbances during and since the World War.

Pre-war levels cannot be considered in present day valuations and whether or not upkeep in all parts of the system, because of those conditions, has lagged is a matter for first consideration, hence the approach to the so-called vicious circle: Service requires upkeep, upkeep must have proper rates; proper rates demand proper service.

The fundamental principle laid down by the Supreme Court of the United States in 1897 (Smythe v. Ames) has served since as a basis on which modern rate making stands.

The Court said: "The Company is entitled to receive a reasonable return for the service it furnishes and no more; the public is entitled to receive an adequate return for the reasonable rate it pays and no more" . . . "what the Company is entitled to ask, is a fair return upon the value of that which it employs for the public convenience. On the other hand, what the public is entitled to demand, is that no more be exacted from it . . . than the services rendered are reasonably worth."

In the New York Telephone case the Court said: "It is enough if it (the property) is used to render service. The Customers are entitled to demand service and the Company must comply. The Company is entitled to just compensation, and to have the service the Customers must pay for it."

What this reasonable worth of service may be, is a most difficult problem for which to find a precise solution. As an index for guidance consideration should be given to:—Market Value of Money, Fair Value of the Property, Financial History in Payment of Dividends, the Amount of Surplus re-invested in the plant equipment, the record of Financial Operations and the Character of the Service rendered.

The tendency of the Courts seems to be to regard property and its value rather than its cost in considering rate adjustments.

As to the proper rate of return, records of decisions of Courts and Public Utilities Commissions indicate an average allowance of about 7 or 8% on the value of the plant used and useful.

In the case of municipal works the rate base may be put at a figure sufficiently high to include cost of expansion of plant, because the rate payers stand in the place of the stockholders whose property the plant is; in the case of privately owned plants this plan is not sound and is forbidden by rate-making bodies as unjust and unequitable to the rate-payers, because of the tendency to make consumers pay for plant which becomes the property of the company, which in turn as value increases, will ask for greater return on an investment a part of which it has not financed.

In the establishment of rates for water services an apportionment must be made between public and private uses and a well balanced return should be worked out on the portion of the investment allocated to each.

In a plant serving a manufacturing city of about 100,000 people the following subdivision was made in the reproduction cost of the distribution system:

Domestic service 44%, Industrial service 37%, and Public Fire protection 19%; the relative capacity of the pipe system required by the different classes of service was, Domestic service 22%, Industrial service 31% and Fire protection 47%.

Service for fire protection, either public or private, is entirely distinct from the service supplying water for ordinary community use.

The former demand "ready-to-serve" features entirely distinct from those of ordinary water consumption, and rate-making bodies have consistently held that the omission of fire protection charges as a separate item in the rate schedule is discrimination in favor of a portion of the community, and therefore unlawful.

The value of fire-protection service is not determined by the amount of water used, but by the property protection afforded to the community as a whole, in the case of the municipality and to the owner himself in the case of private supply.

Many specious arguments are put up by private interests against a charge to them for service in their private water systems, but the fact remains that service is given which costs money to the community and by this service the individual receives much personal profit from a great reduction in insurance rates, as well as assurance of continuity in his business.

The annual quantity of water used for fire-protection from a supply system is comparatively small, but the amount required for concentration during a short time on any one fire may be considerable; hence the large size of the pipes, the excess capacity of the pumping plant, and the reserve in storage capacity of distributing reservoirs.

The best method at present devised for proper allocation of charges for water service appears to be for consumers to pay directly for such use as is of personal benefit, and for property to pay indirectly through an increment in the tax levy for protection against fire.

The cost of fire protection service is considerably more than is generally recognized. In communities of from 5,000 to 300,000 people the cost of this feature may vary respectively from 75% to 15% of the total cost of the works, and rate-making bodies have allowed from a quarter to a third of the gross revenue to be charged to this service.

The best method of arriving at this charge is by computation based upon the number of "inch-feet" in the water main system, and to this add a reasonable amount for hydrant maintenance.

(Continued on page 98)

HEATED BY GAS FUEL

The NEW HOME *of the*
Boston Consolidated Gas Company
100 ARLINGTON ST.
AT COLUMBUS AVE. & STUART ST.

An Invitation

Technical men in all branches—especially those interested in building, designing or construction—are cordially invited to inspect this Gas Fuel Heating Equipment in our new building—now—while its heat is being used to help in drying the masonry, concrete and plaster in the floors, walls and partitions.

Arrangements may be made for group or class demonstrations if desired

Telephone Beach 7060

The Gas Fuel Heating plant installed and now in operation in the new Gas Building is an outstanding example of the most modern type of heating equipment—a marvel of heating efficiency and flexibility.

It demonstrates the absolute cleanliness, compactness, ease of control and freedom from fuel shortage assured wherever Gas is used for heating.

This installation of six, twenty-burner boilers capable of maintaining the 2,175,000 cu. ft. of space at 70° in zero weather. Thermostatic control automatically regulates the gas flow to the heat required. Or, if desired, any of the boilers may be cut out of operation.

The Gas Fuel comes into the building through a pipe and is automatically distributed to the heating units.

No fuel bins or tanks are needed, and no space, equipment or disposal need be provided for non-combustible residue as this, together with the smoke and soot from crude fuel, is eliminated at the gas plant. Nothing but the heat-producing element—Gas—comes into the building.

The boiler and burner units used in this installation are exactly the same as those adapted to heating under all radiation requirements large or small—for homes, stores, business blocks, churches, auditoriums, institutions or wherever heat is needed.

Boston Consolidated Gas Co.

The Opening Banquet

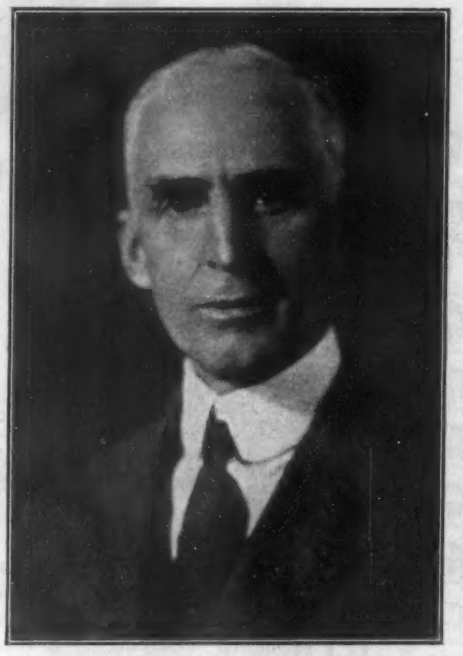
(Continued from page 67)

hardness of exact science, and the tenderness of the nurse, are summoned to the aid of every city. His Excellency, the Governor of Massachusetts presides over an organism of administration more complex, more interesting, and calling for more diversified talent than any system of government ruled by any European monarch from the fall of man to the end of the eighteenth century. President Stratton does not appear in the headlines, is not featured in the movies, and may not be as well known as Charlie Chaplin, but by his long, patient, and intelligent services in a single bureau in Washington, he set in train operations in one field alone which, on a conservative estimate, save the people of the United States every decade a sum equal to Henry Ford's fabulous fortune, to say nothing of his other achievements even more significant in character. To add another illustration from a thousand that could be adduced, it is noteworthy that at least one-third, of all the trained civil engineers in the United States are in the employ of our governments, national, state, and local.

Besides calling for all sciences, crafts, arts, and professional lore, the state uses in its operations all known materials, from asphalt to zinc, considered alphabetically. For its museums, it must even judge the quality of the fine arts.

In carrying on its operations, the state takes an increasing amount of the citizens' wealth, whether an increasing proportion, we do not know. As a mere illustration, the city of New York spends about five hundred dollars a year per family for community purposes a sum equal to at least three times the average annual family income in China.

And the upshot of it all I now desire to put in a single proposition: "The study of the state, its functions, its role in civilization, its relation to national grandeur and destiny is as worthy of our labors as the study of technology, is indispensable to the indefinite progress of technology, and deserves an endowment and equipment equal in proportions, deserves the consideration of minds equal in capacity, and calls for the same kind of scientific approach that has made invention the glory of our country." As integral parts of our engineering schools, our business colleges, and our universities, let us build schools of public administration and government, remembering with Emerson that the state follows, at a distance and haltingly, its thinkers and that thought summons us to live not by bread alone but by the noblest use of our national opportunities, doubting not that



CHARLES A. BEARD

America standing in the full plenitude of her youth, equipped as the strong for the race, will earnestly strive to cast off the dross and win for herself a high place among the creative civilizations of history — those that have gone down over the horizon and those that are to come as the dawn approaches the noon.

Mr. William C. Deming, chairman of the U. S. Civil Service Commission was the next speaker of the evening. Dr. Deming commented briefly on those who helped to make the civil service reform an actuality and then proceeded to outline the growth of the civil service. He showed the need of civil service reform which became evident during Andrew Jackson's administration and reached a climax, with the assassination of President Garfield in 1881. This tragedy was responsible for the Pendleton Act of 1883 which created the Civil Service. He then described the organization necessary to conduct the examinations and gave some very interesting statistics. The number of positions to be filled by civil service examinations has been greatly increased to the benefit of the whole country. Recently finger prints have been made of all candidates in order to detect criminals.

A striking illustration of the value of finger printing was experienced in the New York City Post Office during the Christmas rush, where the weeding out of applicants for temporary employment by means of the finger print system reduced mail losses fully 50%.

During the last four years the evil of the "special expert," inherited from war-times has been practically eradicated.

Large establishments like the Interstate Commerce Commission have placed upon the Commission the responsibility of selecting certain grades of attorneys, though not required to do so by law.

Schedule A excepted positions in many bureaus are being changed to Schedule B positions, in which a proper noncompetitive test is administered.

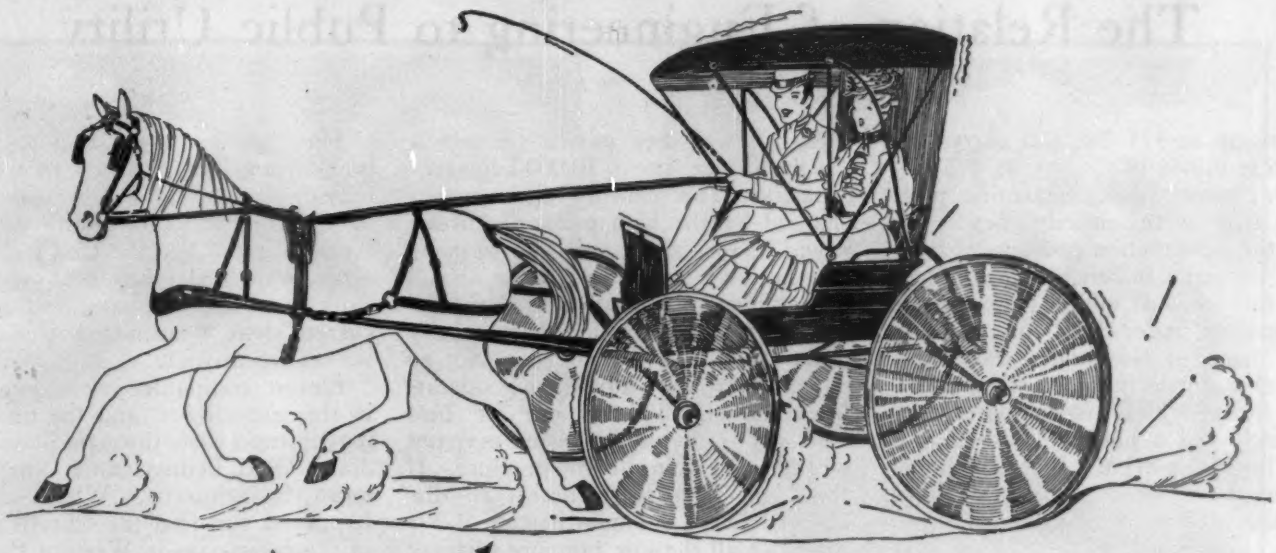
Perhaps the greatest single advance has come within the last two weeks when the Prohibition forces of the United States were classified, involving 2,500 places.

The holding of an examination under an Executive order for first, second, and third class postmasters has been a great advance. It is only a question of time when Congress will see the wisdom of giving the Civil Service Commission full responsibility for all grades of postmasters. There are 15,000 such places and when they have come in, as they surely will in time, the last real stronghold of the spoils system will have fallen.

Our Government exercises jurisdiction over public lands. It protects and preserves extensive forests; it supervises rivers and harbors; it studies commerce; it investigates labor conditions; it levies taxes; collects revenue and conducts a great federal reserve banking system.

Federal experts guard the food we eat; watch public health; deliver letters and packages; transport baby chicks and fresh eggs by parcel post; dig canals and regulate bridges over rivers. They study the habits of bugs; distribute garden seeds; standardize concrete, automobile tires, and ice cream; and improve mining conditions. They build air ships and flying machines; collaborate in highway construction, and with agricultural colleges; in brief, leave little or nothing undone which will promote the welfare and the happiness of the American people.

(Continued on page 92)



Thank you, M'arm!

IN the days of buggies and puffed sleeves, a "thank you, M'arm" was an occasion of rejoicing on the part of the young Don Juan who flourished the whip. The Gibson girl by his side probably protested vociferously against such pitfalls but, nevertheless, she undoubtedly regretted the stretches of newly laid brick, where all was smooth and there were no bumps to encourage a laggard beau.

A quarter of a century has changed all this. "Thank you, M'arms" are an occasion for something other than rejoicing—broken springs rather than wedding rings are the result. Instead of being avoided, brick-paved roads (many of them the same) are sought out, for the present generation knows that while "thank you, M'arms" brought a temporary joy, lasting pleasure is given only by a well-paved and permanent surface.

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION
ENGINEERS BUILDING CLEVELAND, OHIO

VITRIFIED
Brick
PAVEMENTS

OUTLAST THE BONDS

The Relation of Engineering to Public Utility

(Continued from page 53)

the steam at 375 lbs. and carrying it down to minus 14.

This meant two engineering problems that were entirely new. One was the construction problem of being able to make boilers, piping, valves, and turbine shell of sufficient strength to operate under 1200 lbs. pressure. The drum of this boiler was forged out of a single ingot of steel, and is four inches thick, as compared with an inch and a half for the ordinary 375 lb. boiler drum. The valves and piping have been made very much thicker and more rugged in every way.

The other engineering problem was would it pay provided it would work. Our engineers by figures proved to their satisfaction that the total cost per kilowatt would not be any greater than for a normal plant, and that the coal efficiency would be from 10 to 15 percent. better.

Under all these circumstances, we were willing to try the experiment, and it has panned out so successfully that we have within the last three months ordered two more high pressure boilers and another high pressure turbine of three times the size of the original one. This was a case where figures were confirmed by practice.

It might be asked "Why was it necessary to put in any boilers at all of 375 lbs. pressure?" That is to say, why could not the two turbine capacities be so proportioned that the high pressure turbine would discharge steam at 375 lbs. pressure in sufficient quantities to operate the low pressure turbine from 375 to minus 14? This question is a very pertinent one. Theoretically there can be only one answer. All steam could be generated at 1200 lbs. and passed through a 1200 lb. turbine, say of 7000 kilowatts' capacity, and then passed through a 375 lb. turbine, say of 30,000 kilowatts' capacity. The quantity of steam discharged by the high pressure turbine would be just about sufficient to operate the lower pressure turbine at full capacity. Quite possibly in the years to come this construction may actually be adopted, but it is governed not so much by capacity alone as by operating conditions. The point of best efficiency in the high pressure may not be the same as in the low pressure. If the high pressure turbines all discharged into a common header of 375 lbs., and all the low pressure turbines fed out from this header, the result in capacity would be the same, but the result in efficiency might be very much better, and it certainly would be far superior in case of a breakdown of any one turbine.

Electricity from this station is to be sent back underground to our existing districts in Boston and vicinity or is to be carried overhead by high tension transmission lines in a so-called ring system, tapping in to what might be called the back doors of our existing distributing system.

Within the last few months a statement in the press has suggested that the Back Bay of Boston was being lighted from the power station in Chicago, or that State Street in Chicago was being lighted by the Edgar Station in Weymouth. An experiment along these lines was actually carried out, but the papers featured it somewhat more vividly than was justified by what actually happened. It is true that Boston and Chicago were actually connected up during this experiment and that current was transmitted either in one direction or the other throughout the entire thousand miles of electric circuit.

This does not mean that any Boston current actually got to Chicago or vice versa, but it does mean that all the companies, including the Boston at one end and the Chicago at the other, were tied together through circuits, were all in phase, and in fact current was transmitted throughout the entire district.

Eleven companies were interested in this experiment, and the line leaving Chicago went through Illinois, Indiana, Ohio, Pennsylvania, New York, and Massachusetts. What actually happened was that the officials of one of the companies in Western Pennsylvania found that they had in their regular operations been able to connect up with Chicago. One of the neighboring companies had in the same way found themselves connected up with Boston, and they conceived the idea that it would be a worth while experiment to make all these connections at the same time, and thus get a through line. This was accomplished without any special prearrangement and it might almost be said that it was done in the usual course of operation. Even if no appreciable amount of current was transmitted, this was a noteworthy feat and has been so considered by the technical press.

If I were to prophesy a little as to the development during the next generation, I would say that the two outstanding problems which confront our industry are first, the question of rural electrification, and second, the question of interconnection.

With the exception of the poorer districts in our large cities, practically all of the United States is supplied with electric current except the farming districts. The cost of reaching the farmer is very high, and the question

(Continued on page 94)

"INTERNATIONAL"

The Name of a Product—the Scope of a Service

THE International Harvester Company is building the best Motor Trucks that can be produced by modern engineering provided with abundant resources. International Trucks are powerful, sturdy, honest, dependable workers; designed to give the user a maximum of mileage, at a minimum cost per mile, over the life of the truck. They are sold at the lowest prices consistent with good business principles, and without resort to injudicious allowances that invariably indicate the omission of some essential service to the buyer.

Motorists driving out from town should follow Commonwealth Avenue to the Packard plant, straight through on Brighton Avenue to Union Square, straight through on North Beacon Street to the International Branch, about four minutes beyond the Packard plant.

INTERNATIONAL HARVESTER COMPANY, OF AMERICA [Incorporated]
61 North Beacon Street
Allston District, Boston

Other New England Factory Branches: SPRINGFIELD, 240 Chestnut St. PROVIDENCE, 103 Broad St. PORTLAND, 315 Forest Ave.

On Timken Bearings
In the epic history of the railroads a new chapter opens. Cars regularly equipped with anti-friction bearings are here. Timken Bearings make it possible. The first standard Timken-equipped cars go into operation on the Chicago, Milwaukee and St. Paul.
Timken Tapered Roller Bearings for this progressive railroad's crack flyers, The Olympian and The Pioneer Limited, mark the day of new ease, quiet and surety in long distance travel.
On guard against the wear and waste of friction, Timken Tapered Roller Bearings not only conserve power, but put an end to hot boxes and the whole lubrication difficulty.
Steel wheels speeding steel grades and curves cause stresses which have been thought beyond anti-friction bearings. Here again, as in every other type of mechanism, throughout Industry, the "impossible" has yielded to Timken design, construction, and resources.
THE TIMKEN ROLLER BEARING CO., CANTON, OHIO
TIMKEN Tapered Roller BEARINGS

Reproduction of two-page Timken Advertisement in The Saturday Evening Post

Railroad trains running on Timken Bearings represent the most significant development in the history of friction elimination. When you realize that Timken-equipped trains can be started with only *one-eighth* of the power formerly needed, and that the old hot box dangers are gone, you begin to sense the meaning of this latest Timken achievement.

For a long time Timken has been approaching this climax. Timken Tapered Roller Bearings have become universal in motor vehicles. They have swept industry, being used in machinery of every type, sponsored by the most highly reputed engineering institutions. In Transportation, Manufacture, Mining, and Agriculture Timken Bearings identify the most modern designs of the most progressive equipment manufacturers.

It is certain that engineers of every class will be increasingly concerned with the greater mechanical endurance and operating economies made possible by Timken Tapered Roller Bearings.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

Every Engineering Department should have the highly informative Timken Engineering Journal—110 pages broadly covering modern bearing practice. Faculty members may have a copy upon request.

Central Stations

(Continued from page 84)

with the condenser and to take up the expansion and contraction of the unit, supporting springs are provided.

The condenser is designed to produce a vacuum of 28½" when condensing 455,000 lbs. of steam with 75,000 g.p.m. circulating water at 70° F. The condensate temperature will be within 1° of the temperature of the exhaust steam and the oxygen content of the condenser will not be in excess of .05 CC per litre.

The circulating pump turbine condensers are two pass containing 700 sq. ft. of cooling surface. Each of these is equipped with two 2 stage steam jet air pumps operating at 250 lb. steam and a 5½" x 5" x 5" duplex hotwell pump designed to deliver 16 gal. of condensate per minute against 135' total dynamic head, including the vacuum. This pump operates at about 20 strokes per minute. These condensers will maintain a 28" vacuum when supplied with 1,000 gal. of 70° circulating water.

The boilers have 14,809 sq. ft. of heating surface exclusive of water walls or superheaters. The furnace construction is interesting in that it is surrounded on all sides by water cooled surfaces in order to eliminate refractory walls.

The induced draft fans are driven by steam turbines with a maximum rating of 400 h.p. The capacity of the fan is 150,000 c.f.m. at 1.6" water gauge. The forced draft fans are also turbine driven with a rating of 115 h.p. The capacity of this fan is 75,000 c.f.m. at 6.4" static pressure.

The Engineer in Politics

(Continued from page 50)

tive part in politics, by lending their strength in any way they can to assist in making our ideals of democracy successful, by helping to prove that it is not necessary to have a despotism or a militaristic state in order to have efficient city and national government.

What a capable engineer can do in political life is illustrated by the remarkable career of Mr. Herbert Hoover. Mr. Hoover, as a member of the cabinet of President Coolidge, has an opportunity for rendering enormously important service to his country and he is rendering that service. The pity is that there are practically no engineers in either the United States Senate or the United States House of Representatives to support Mr. Hoover in his constructive ideas and few engineers elsewhere in public life, except those filling technical positions.

The great reason why engineers should be in politics is because America needs them. Activity in politics will benefit an engineer personally and make him more capable of holding an important administrative or executive position; but, much more than that, it will give him a great opportunity for doing good for others. In the old days of chivalry there was a phrase current—"noblesse oblige." To the modern American engineer and, especially I hope to the graduates of the Massachusetts Institute of Technology, the interpretation of this might be: "If you have good judgment and

(Continued on page 100, column 3)

Opening Banquet

(Continued from page 88)

While there may be in public life those who have not yet learned to keep pace with the march of progress, and would hark back to a time when the classification civil service was a joke and a byword, they are out of touch with the spirit of the age.

The tide of the merit system will continue to flow and the era of spoilsmanship will continue to ebb until all the civilian forces of the government will enjoy tenure based on efficiency and not on the whim of politicians or the vicissitudes of changing administrations.

If we may call the Declaration of Independence our great charter of liberty, and the Constitution the compass by which the Ship of State is held in its course, we may designate the merit system the ballast which preserves an even keel in the stress of political storms.

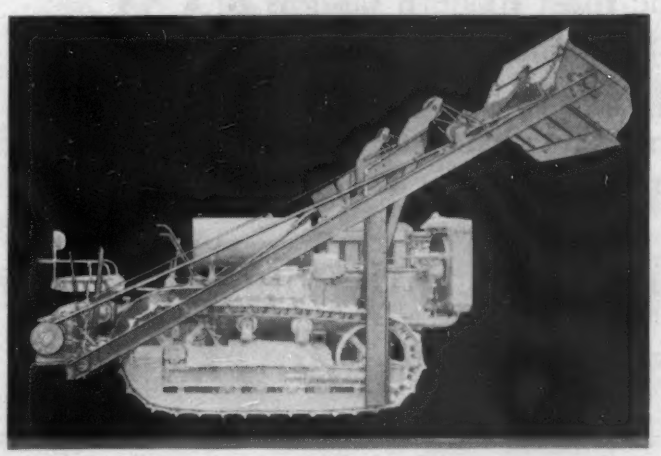
Disposal Problems

(Continued from page 82)

the treatment process, or the results which should be obtained.

The foregoing fragmentary discussion of a few of the features of The Sewer and Sewerage Disposal Problem of a City illustrates the need of the expert and the trained engineer in the public service. In the past they have been few, but at present there is unmistakable evidence that greater effort is being made to secure such assistance, and the future holds much of promise.

Caterpillar Tractors for All Purposes



EASTERN TRACTORS CO.

HAYWARD and AMHERST STREETS

CAMBRIDGE

MASS.

Measuring the Life Stream of Your Community

The supply and distribution of water is the biggest and most important business of the community. The size, health, safety of the population, the concentration of industry, the protection of property, the life of every individual in the community depends upon an unfailing supply of water.

Water is precious. It must be measured so that revenue may be collected. Waste must be prevented.

The Hersey Manufacturing Company for forty years has concentrated on the problem of building water meters for every conceivable kind of service. Hersey Meters are known throughout the world for the excellence of the service which they render.

Hersey Manufacturing Company, South Boston, Mass.

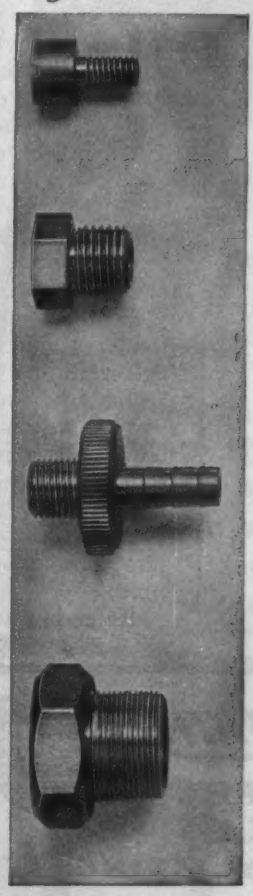
HERSEY
WATER METERS

NEW YORK, N. Y., 290 Broadway
PORTLAND, OREGON, 475 Hoyt St.
PHILADELPHIA, PA., 314 Commercial Trust Bldg.
ATLANTA, GA., 510 Haas-Howell Building
DALLAS, TEX., 2301 Griffin Street
CHICAGO, ILL., 10 So. LaSalle St.
SAN FRANCISCO, CAL., 690 Market St.
LOS ANGELES, CAL., 450 East Third Street

Main Office and Works: Corner E and 2nd Streets, South Boston, Mass.

Faster machines mean still lower costs to the consumer

Although the average person seldom realizes it, when he gets a serviceable clock, safety razor, or any of thousands of articles in daily use, his thanks for their low cost are partly due the Brown & Sharpe Automatic Screw Machines. Their ability to keep costs down lies in their automatic operation and the rapidity with which they produce accurately formed parts.



And now, to further increase the production and to make the cost still lower on work similar to the pieces at the left, the Brown & Sharpe Mfg. Co., have placed on the market a line of High Speed Automatic Screw Machines. These machines operate with spindle speeds up to 5000 R.P.M. and are particularly suited for speeding up the production of parts made from the softer metals, such as brass.

Every student engineer should become familiar with these machines which hold so important a place in modern manufacturing. We are always ready to send at your request descriptive material covering these machines.

BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I., U. S. A.

The Relation of Engineering to Public Utility

(Continued from page 90)

"Who is to pay the bill?" is the one at issue. The Company cannot afford to make the extension unless it can see a reasonable return, and the farmer is in very much the same situation, especially as the majority of farmers in this country are tenants rather than owners, and therefore cannot be expected to make any large investment. On the other hand, the manufacturer has had no inducement to develop apparatus especially designed for farm use, and just how to bring about the same amount of electrification on the farm as exists in other lines of business is a very weighty problem which is attracting the attention of the engineers and of the commercial men of our industry.

The other problem is interconnection. Interconnection is no new idea. The connecting tie line which we installed here in Boston in 1890 between the Atlantic Avenue Station and the First and Second Stations was an interconnecting line, and it differs only in degree, but not at all in kind, from the line which I have been describing as now running from Boston to Chicago.

We have had two parallels in our industrial life or rather in our transportation development, which illustrate the principle of interconnection.

If the Lincoln Highway had been designated simply as a method of connecting up existing systems of road, so that a main thoroughfare thus would be created between New York and San Francisco, it would, as a matter of fact, have attracted very little attention. The name, however, caught the public eye and today, or if not today at some time in the near future, one can travel from coast to coast, seeing the Lincoln Highway sign throughout the entire distance.

The Lincoln Highway when completed will be nothing more than a so-called superpower road, enabling the citizens of one city to travel to neighboring cities, and citizens of those in turn to travel to other cities, and so on ad infinitum.

Another illustration: The steam roads of our country a half century ago were in a similar condition to the automobile roads of fifteen years ago, or to our power line situation as it is today. The interconnection in steam roads has been practically completed, whereas the automobile interconnections are in process, and the power line interconnections are just beginning.

Referring to the railroad analogy, the Pullman Company by an arrangement with all the roads, has enabled passengers to go from New York to Chicago, or from Chicago to San Francisco, without change. It is merely a superpower company, providing an interchange of passengers from one community to another with ease and comfort.

The superpower line running from Boston to Washington, had all the characteristics of the Lincoln Highway, in automobile transportation, and the Pullman Company in steam railroad transportation.

The simile can be carried one step further. One of the difficulties of exchanging power between two companies located in neighboring cities was that the two companies might not employ the same number of electric cycles. That is to say, if Baltimore had sixty cycles and Washington, because of the preponderance of railway business, had twenty-five cycles, the interchange of power became very difficult.

This was paralleled in the steam railroad world by the narrow gauge system running from Denver to Salt Lake City fifty years ago. Passengers had to change cars not because the Pullman Company was not prepared to run a through car, but because it was a physical impossibility for the same car to run on both gauges.

If the Pullman Company did not exist and there was no company doing their sort of business, the effect upon the railroad companies' investments would be tremendous. If the Pennsylvania Railroad, for example, had to own all the parlor, sleeping, and dining cars required to take care of the peak of its business, and every railroad in the country had to do the same thing, the number of cars of this character necessary to be owned by all the railroads would be far in excess

(Continued on page 96)

Selected Grades

Anthracite

and

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COAL

BURTON-FURBER
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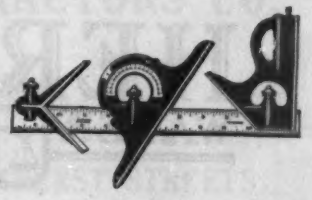
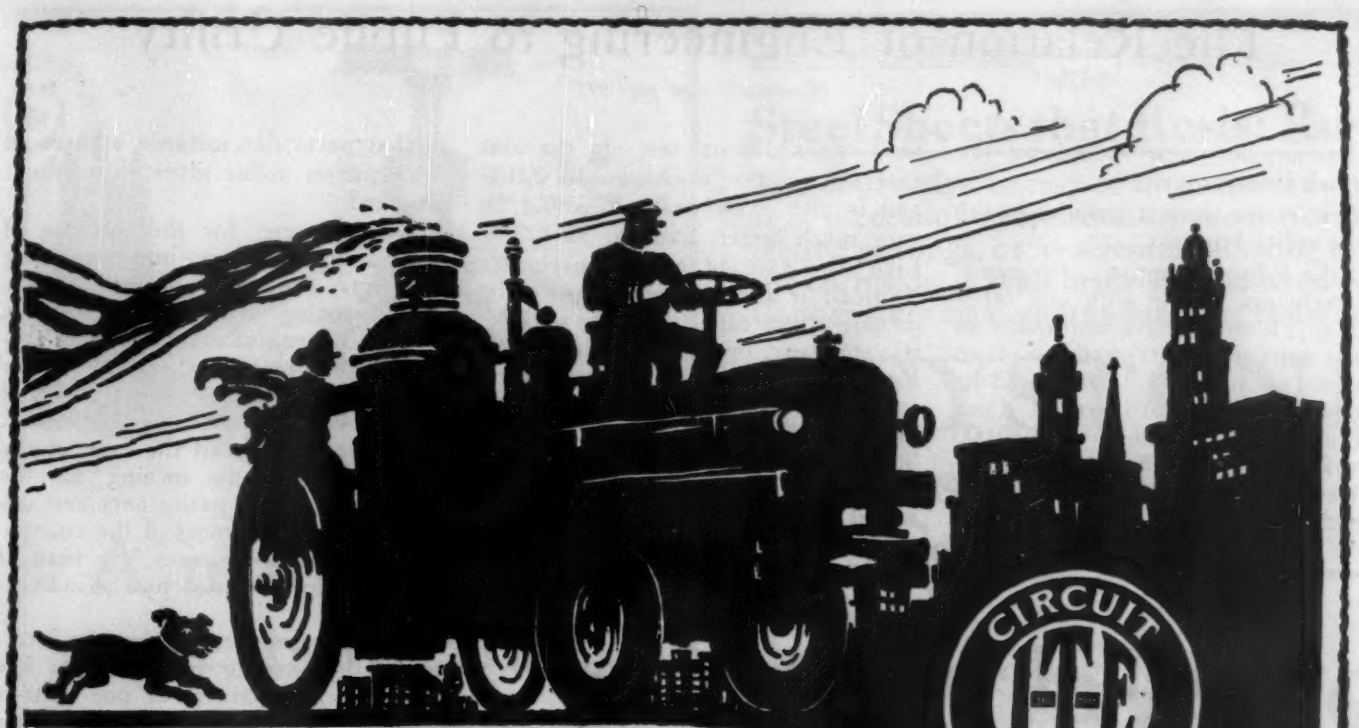


DISTINCTIVE IN QUALITY

Made in patterns best suited to every class of work

SEND FOR
Cat. No. 11—Tapes and Rules Cat. No. 5—Tools

THE LUFKIN RULE CO SAGINAW, MICHIGAN
NEW YORK WINDSOR, CAN.



PROTECTION!

FORTUNATELY, it is no longer necessary for us to stress the importance of proper electrical protection.

There are few engineers today who do not smile when they think of the innumerable fused switches they have used in the past.

They admit today that circuit breaker protection pays in the end. They know that the I-T-E Circuit Breaker has been, is, and we trust always will be, the leader.

And why should this not be the case? Cutter has devoted forty years exclusively to developing the I-T-E Circuit Breaker art as it has come to be known today.

1250 ampere 3 pole 2 coil Overload and Autoite (non-closable on overload) I-T-E type L L hand operated *transfer breaker*, so arranged mechanically that both breakers may be opened at the same time but not closed.

Cutter makes a specialty of transfer breakers. They can be built to be either hand or electrically operated, over a very wide range of capacities—in fact, we have yet to find our limit.

THE CUTTER COMPANY
PHILADELPHIA

When writing to advertisers please mention
The Tech Engineering News

CUTTER

U-RE-LITE I-T-E CIRCUIT BREAKERS

12

The Relation of Engineering to Public Utility

(Continued from page 94)

of the number now owned by the Pullman Company.

Now let me draw a parallel in the public utility business.

If the Edison Company, for example, were not tied in with any other company, it would have to provide an excess capacity in its stations of an amount equal to at least one of its standard units. That is to say, if our station had, for example six 30,000 kilowatt units, it would need in reserve at least one 30,000 kilowatt unit. If it had only three units it would still need one additional set. In the first case the reserve would be 16 2/3% and in the second case it would be very much larger, namely, 33 1/3%. Like the case of the Pennsylvania Railroad, it would be equivalent to its owning all its cars. Suppose an electric company, operating in the city of Providence, was in exactly the same condition. If an interconnecting tie line of sufficient capacity could be built between it and another city such as Boston, the two companies together would need only one set in reserve and in that particular instance a three to four million dollar investment would be saved.

Now assume, for the purpose of illustration that an interconnecting line was run from Boston to New York, passing thru all the cities en route. Instead of each company having its own reserve, the total reserve needed would be very much less and millions could be saved in investment. This is analogous to the case of the Pullman Company owning all the sleeping cars and parlor cars and doing the entire business of the country with thousands of cars less than if they had to be owned by the individual roads.

For the same reason that the interconnection among the railroads has enabled the products of one district to be easily transported to another and thus to be of advantage to both districts, the construction of these interconnecting power lines is enabling water powers, on the one hand, and steam powers, on the other, to work hand in hand. Until very recently steam powers could not get the advantage of cheap water power for their base load, neither could water powers get the advantage of steam connections for reliability. This development, therefore, has marked a new era in combining the advantages of steam and water power into one enterprise. This is in fact true inter-connection and the word superpower is particularly misleading in this connection.

The foregoing indicates to a slight degree the part which engineering plays in the operation of a public utility, and when we realize that the vast amount of money necessary for construction and operation is spent by the engineers or under the direction of those connected with the engineering profession, we appreciate how closely the engineer is related to the success of the industry.

If the future can be measured by the experience of the past, we may expect that the coming engineers will meet many interesting and important problems, the solution of which assure the development and continued success of the Public Utilities.

Engineers have devised accurate instruments to determine the demolition effect of various powders, but it does not take a very mathematical mind to figure out the explosion that powder found on a man's shoulder will produce.

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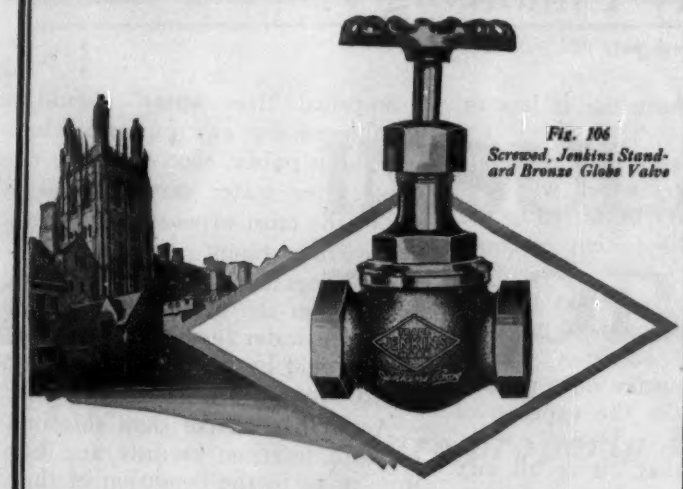

Fig. 106
Screwed, Jenkins Standard Bronze Globe Valve

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Water Supply Financing

(Continued from page 86)

There are three recognized divisions of the cost of water service, customer, demand and production. Customer costs are those placed on the works by necessary duties to be performed irrespective of the amount of water used or whether any water is used at all as, maintenance of the individual service and meter, reading meters, billing and collecting. The demand charge also is irrespective of the amount of water used, and relates to the capacity of the system and ability to give the customer what he wants, when and as he wants it. The production charge relates entirely to the quantity of the product used and varies directly with the demand.

The first two of these items constitute the basis of the so-called "service charge," i. e. a charge made for ability to meet the desire of the consumer when and as he calls.

The prevailing tendency in rate-making is away from a uniform rate and toward a sliding scale schedule that will enable the large user and the long hour user of the utilities facilities to secure a more advantageous rate than others whose use is less or intermittent.

A municipality should not be allowed to charge rates which will produce a surplus to be transferred to the general fund for the benefit of those who pay taxes.

All rate payers are not tax payers, and a jumbling of accounts is not conducive to business efficiency, beside putting an unfair burden on a portion of the community at the expense of another.

The argument that "it is all city money and the use of water department funds is merely taking from one pocket to another" is the specious argument of political exigency and will not bear investigation or logical argument.

Accounts should be kept entirely distinct, and made up as accurately and in as much detail for municipal work as is required in any well managed private utility.

In the case of the municipal department, taxes may be remitted in lieu of payment for fire protection from the water system but even this is of doubtful value.

So-called "free water" should not be allowed for any purpose whatsoever, be it public, semi-public or charitable; free water service is usually one of the most expensive leaks in the water department service, and is frowned upon by public utility bodies, as being in the nature of discrimination. All water furnished for any purpose should be paid for at the established rates.

Any other course than this is suicidal to financial records and blocks inquiry as to the condition of the department's finances and whether or not the business is being conducted in a business way.

The propriety of the service charge has been sustained by the public utilities commissions in nearly all of the states and upheld by court decisions.

There is, however, general opposition to it and often times the best compromise is the so-called "minimum" rate, i. e., a fixed charge, usually dependent on the size of the meter, which must be paid whether or not water is used, but allowing a certain

(Continued on page 104)

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Thermit Welding

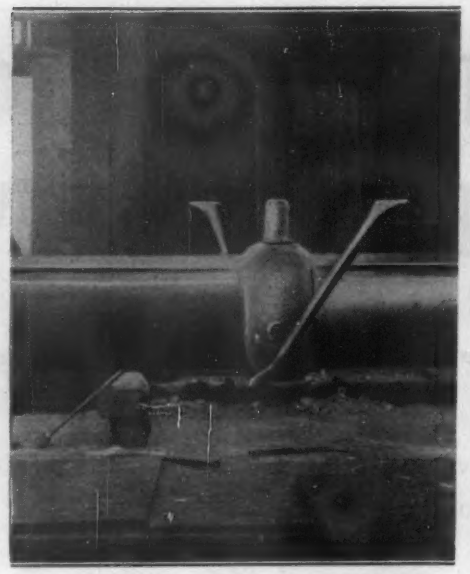
(Continued from page 59)

provided so that nothing need be left to the judgment of the operator.

Thermit welding has developed in twenty years from a very crude process, which frequently resulted in unsound and porous welds, to one in which every weld—barring very infrequent accidents—is perfect. The excess metal applied during the welding operation is necessary in the making of the weld but is not, as many think, a re-enforcement which should be left on. In many cases, this excess metal is completely removed and in all cases the weld is at least as strong as the parts welded.

The process is suited to small welding operations but in light work it is frequently more expensive than the oxy-acetylene or electric process. It is used principally in the welding of all cast-iron or steel sections over 3 inches thick and on such sections its great economy is evident.

The tensile strength of unworked and unheat treated thermit steel produced by the thermit most commonly used is about 70,000 pounds per square inch with an elongation of 20 per cent to 25 per cent in 2 inches. Other thermits just as easily manufactured produce steels having tensile strengths of 55,000 pounds with 40 per cent elongation, or steels with tensile strengths over 100,000 pounds with 6 per cent elongation. It is evident that since the thermit steel is produced by the reduction of iron oxide by means of aluminum and that since the carbon-free metals in the steel industry—such as chromium, vanadium, titanium, etc.—are produced in this same way, that mixtures can be placed in the crucible which will produce steels of any desired composition. Thermit steels are, it is true, cast steels, but are so pure as to have no weakness at the grain boundaries and consequently exhibit all the properties of forged steel. The thermit process has been approved by the American Bureau of Shipping and by Lloyd's Register of Shipping for use in the repair of stern frames and other important heavy sections of steamers, and in the last few years many hundreds of ships have been welded in this way without a single recorded failure.



A RECORD WELD

This twenty-six inch diameter Blooming Mill shaft was welded in 48 hours by the described process.

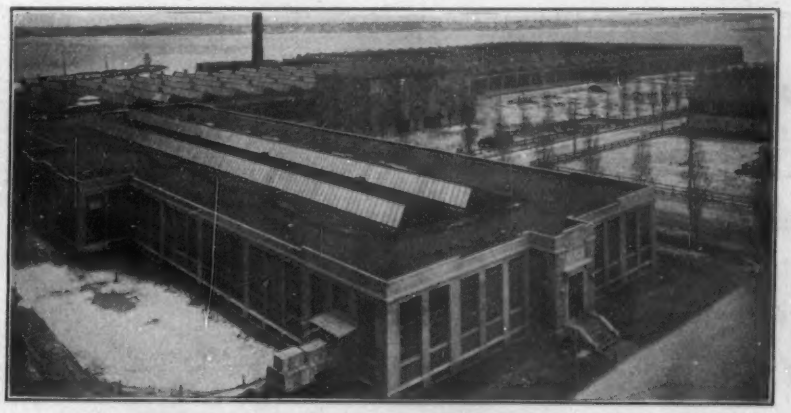
In the steel mill, where it used to be more economical to remake a broken part, the thermit welding process has now become so economical that thermit welding reclamation departments are being organized in plant after plant, and one plant alone of an important steel company employs a large force of men for this work, using almost 100,000 pounds of thermit per year and is making very large savings. The work is done on all iron and steel sections, including table rolls, rolling mill housings, blooming engine parts, crank-shafts, connecting rods, charging peels, etc. A great deal of work is also done, by the use of a special thermit, in replacing the wear on wobblers and the metal can be so accurately added as to require no machining and is so hard as to be just barely machineable and resists wear indefinitely.

One of the largest appeals for thermit welding is that of rail welding in paved streets. This work is being done by most of the important trolley roads of the country and is so simple that it is handled by the trackmen themselves after a few weeks' instruction by a supervisor. The entire ends of the rail sections are welded together so that the rails are endless and the wear at the weld is no different from that in the rail itself.

The result of a thermit weld in cast-iron parts is just as satisfactory as in steel with the possible exception that since much of the cast iron is melted and alloyed with the thermit steel, the high carbon of the cast iron produces a high-carbon content in the thermit steel which makes it hard to machine. The weld, however, is considerably stronger than the cast iron itself and is very satisfactory.

(Continued from page 92, column 2)

clear vision enough to know how parties and governments should be run in a democracy and have some ideals of public service, it is your duty and your privilege to do your share in political work and strive to make your work effective for the good of all."



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From The Tech, Official Undergraduate News Organ, M. I. T., October 29, 1926.

Ripping Up New Pavement Causes Much Discussion

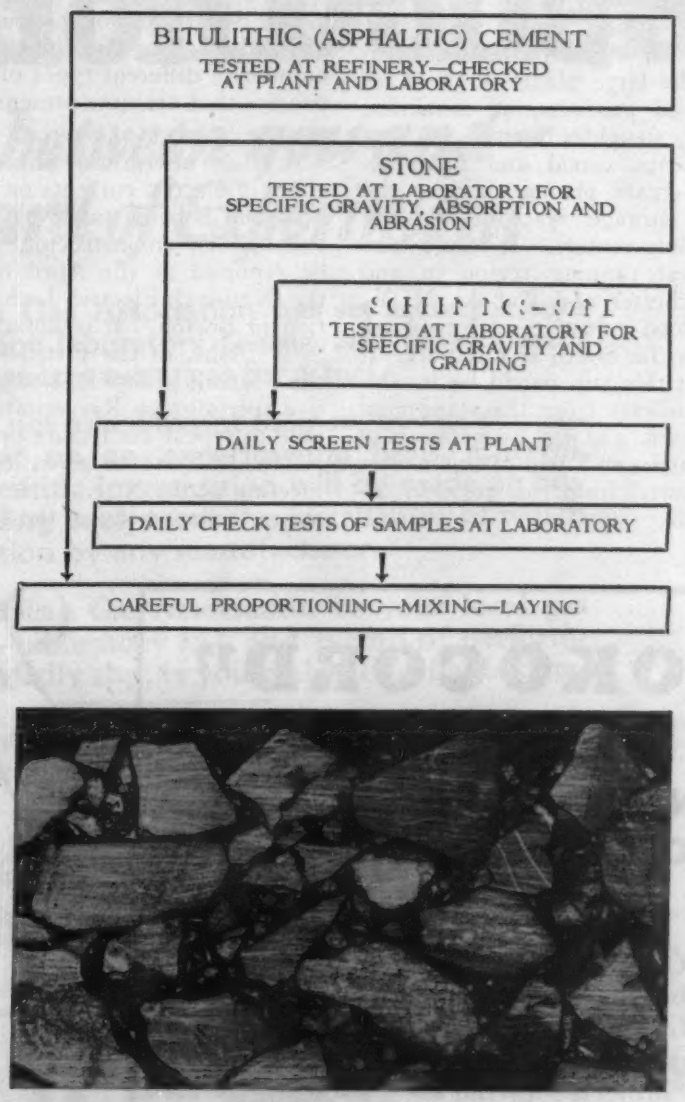
For the eighty-fifth time that day the operator of the steam roller tipped back his hat and prepared to answer what was to him a stereotyped question. "Why are they ripping up the pavement that has just been laid?" His answer was short and to the point, "I don't know," and referred the enquirer to Warren Brothers Company.

The technical service department of the company explained that when the pavement was laid, a very slight depression had formed in two spots and a patch was ordered laid over the hollows. When the patched areas were inspected again it was found that the material laid on had formed a slight hump, scarcely noticeable and satisfactory enough to be passed by the City Inspector.

20 Square Yards Replaced

Unwilling, however, to allow any patched job to go through, officers of Warren Brothers ordered the patched strips, amounting to over twenty square yards, to be ripped up and replaced with new pavement. The sight of seven men attacking the new-laid pavement with picks and shovels, was the cause of the many questions addressed to the operator.

The road had been awaited for a long time, as the macadam road in front of the Institute was in very poor condition. The city of Cambridge appropriated $50,000 to be expended in laying a road from Massachusetts Avenue to Wadsworth street, of the most modern and approved type. The concrete base, six inches thick, was laid by the city, at an approximate cost of 95 cents per square yard.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Vertical cross section. Either crushed stone or gravel may be used as coarse aggregate

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Departmental Notes

(Continued from page 58)

Royal Government, through Dr. Hugh M. Smith, former United States Commissioner of Fisheries, and now head of the advisory board on Fisheries for that country. One of the students is a graduate of the University of Pennsylvania who has since been on the teaching staff of the University of Bangkok.

A trip for students in the Food Technology option is now under discussion which would include visits to many of the large plants in the East making food products, as canneries, flour mills, slaughter houses, packing establishments, cereal and manufacturers ice-cream plants, dairies, the large cold storage warehouses, and food handling centers. It would take in the great canning region in and about Rochester and Buffalo, N. Y., the large food industries of New York City and as far South as Pittsburg. It is felt that this trip would be invaluable to students from the standpoint of experience, and the cooperation of such industries in a trip of this nature seems assured from the inquiries already made.

Researches are being carried on at the present time on micro-organisms which are responsible for the destruction of textile materials by mildews.

Prof. C. E. Turner '17, who is on leave of absence for the present term, is engaged in establishing a system of health education in the public schools of Cleveland, Ohio. Under his direction a series of studies are being made in this department on various methods of hand washing and the efficacy of a number of different types of soap dispensers that are now present in public places.

A study of certain phases of the effect of electric currents on the living organism is being made by Dr. B. E. Proctor '23, an instructor, which will be reported at the April meeting of the National Electric Light Association in Boston. It is hoped that Mr. S. W. Ashe, of the Pittsfield plant of the General Electric Company, who is a specialist on Resuscitation will be able to repeat his lecture on this subject which is to be given at the same meeting of the N. E. L. A. before the entire student body of the Institute.

The industrial hazards which are especially concerned with the concentration of carbon monoxide in garages and automotive laboratories is about to be made the subject of especial investigations by the staff of the department, especially as a possible case of this nature, effecting the vision of one of the staff in the M. I. T. automotive laboratory has been reported.

Experimentation on the effect of polarized light on enzymes is being carried on by E. G. E. Anderson, research associate, and it is planned to also study the effect of polarized light on the biochemical activities of bacteria.

Dr. K. Morikawa, who was a research assistant during the fall term has resigned in order to continue his studies in Germany, and expects to return to Hokkaido University, Japan, about the first of next year.

The recently announced pre-medical course has already attracted several students, the majority of whom are transfers from other colleges, who were not previously aware that M.I.T.

(Continued on page 104)

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Water Supply Financing

(Continued from page 98)

amount of water without extra payment. All water used over this amount is paid for at the regular rates.

The use and installation of meters on consumer's service pipes must be considered as an integral part of the water supply financial structure.

Under the so-called flat rate service, customers grow careless and allow faucets to remain open and leaking plumbing to go unrepaired.

Such conditions bring nearer the time when large expenditures of money must be made for extensions of the supply system, and it can generally be shown mathematically that the cost of meter installation is more than saved in interest charges by delay in the larger expenses of additions to the works.

Meter installation, however, is not and never can be a substitute for needed additional supply works and it is the part of wisdom for every water supply utility, whether privately or publically owned, to see to it that it has a plentiful supply of water in sight to meet future as well as present demands.

Every well conducted utility establishes reserve funds for depreciation or retirement to replace such parts of the plant as become useless or inefficient through obsolescence, change in the art or accident.

This fund is sacred for its purpose and may not be drawn on for ordinary expenses of operation; it may, however, under certain conditions, be invested in capital expenditures.

Capital expense may be financed from surplus (net income), long term bond issue, or customer contributions.

The long term debt should be undertaken only under stringent requirement of use, future payment and sinking fund requirements for amortization.

Net income may well be applied to the minor and less expensive parts of the plant, such as street mains, hydrants and meter installations; while the avails from the long term debt should be used for major structures such as transmission mains, filter plants, reservoirs and impounding works.

This method assumes that present rate payers should be called upon not too largely to finance large works of the more permanent character from which future generations will derive equal benefit; but that an equitable adjustment of present and future interest be made through interest and sinking fund payments.

(Continued on page 106)

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Departmental

(Continued from page 102)

offered such adequate facilities in those phases of instruction. Two men taking this course last year are now enrolled as first year men at the Harvard Medical School, Edgar Holmes '26 and Egon Kattwinkel '23 who was originally a graduate of Course XV.

The sixth Sedgwick Memorial Lecture, in memory of the late Prof. Sedgwick, former head of this department, will be held Friday afternoon, April 8, at M. I. T. with Dr. Haven Emerson as the lecturer. Dr. Emerson is Professor of Public Health Administration at Columbia University and his subject will be "Public Health Diagnosis." This will be a discussion of the origin and present developments of diagnostic methods applicable to communities seeking better health. The subject is of especial interest to the department in view of the excellent surveys of the different phases of public health activities of Boston made during the past two years by Prof. Horwood '16 of this Department, Prof. C. E. A. Winslow '98, of Yale University and Dr. Emerson himself.

Dr. V. A. Moore, dean of the New York State Veterinary College of Cornell University, a special lecturer in the department, will hold a series of conferences with the advanced students at an early date. Dr. Moore is recognized as one of the foremost men in America on the subject of the relation of animal diseases to public health and to food problems.

Announcement will shortly be made of a Public Health Institute to be held in the department during the month of July for Health Officers and other Public Health Workers. This will be carried out with the cooperation of the Metropolitan Life Insurance Company and will cover the principal aspects of work of the Health Departments and Health Agencies. Well known specialists will present lectures on different phases of the work.

B. E. Proctor '23

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PITTSBURGH
POTTSVILLE, PA.
ST. LOUIS
SALT LAKE CITY
SAN FRANCISCO
WILKES-BARRE

Water Supply Financing

(Continued from page 104)

Customer contributions may be obtained from payments for service installations, assessments against property for main pipe installations, and other expense for work from which the customer derives a special advantage not shared by all of the rate payers.

In this connection, however, careful determination must be made of the purpose of the intended benefit, as it is not necessary that all should actually use if the benefit is such that it may be of some value to the district as a whole.

To get the best or even necessary water service, in some cases is a difficult and serious matter, due to financial conditions or the ability of even a willing public to undertake the expenditures which are beyond their power.

To overcome such obstacles, private capital may be enlisted and a franchise given which will be attractive to capital and permit of such consolidations and economies of operation as will provide the required service, at reasonable rates.

Another way out of this difficulty and one which at the present time is very highly considered both here and abroad, is the creation of water districts.

The boundaries of these may well be the natural configuration of the locality, rather than the political subdivisions of the State.

Collectively such community interest can finance undertakings far beyond the power of any single unit, as a bonding capacity may be set up independent of the several cities and towns comprising the district.

The district method for the publicly owned and operated plant is somewhat analogous to the business methods of the so-called Holding Company, which by obtaining control of a number of individual plants is able to scrap inefficient and duplicate apparatus and by unification of output, establish large capacity units with resulting economies of operation.

As a general rule, it appears that individual communities are jealous of each other and loth to combine for mutual advantage; opportunities are lost thereby and privileges that might be theirs are wanting because of unwillingness to cooperate.

It is probable that the State has possibilities all untouched and undreamed of at the present time if only approach can be made in the right way.

Prof. W. J. Brown of the University of Adelaide, So. Australia, has summed up this thought in his recent book, "The Underlying Principles of Modern Legislation,"—"If then we take the various forces already mentioned and regard them in combination—the pressure of social and economic problems, the demonstration of our political machinery and the growth in the sense of collective responsibility,—we must conclude that the supreme problem of the future will be, not how to thwart the movement toward State control, but how to direct it in such a way as to achieve legitimate ends without sacrificing the individuality of the citizen."

WIRE automobile and airplane wires, electrical wires, submarine cables, bridge-building cables, wire rope, telegraph and telephone wire, radio wire, round wire, flat wire, star-shaped and all different kinds of shapes of wire, sheet wire, piano wire, pipe organ wire, wire hoops, barbed wire, woven wire fences, wire gates, wire fence posts, trolley wire and rail bonds, poultry netting, wire springs, concrete reinforcing wire mesh, nails, staples, tacks, spikes, bale ties, steel wire strips, wire-rope aerial tramways. Illustrated story of how steel and wire is made, also illustrated books describing uses of all the above wires sent free.

AMERICAN STEEL & WIRE COMPANY

Sales Offices

Chicago New York Boston Cleveland Worcester Philadelphia Pittsburgh Buffalo Detroit Cincinnati Baltimore Wilkes-Barre St. Louis Kansas City St. Paul Oklahoma City Birmingham Memphis Dallas Atlanta Denver Salt Lake City

Export Representative: U. S. Steel Products Co., New York

Pacific Coast Representative: U. S. Steel Products Company, San Francisco, Los Angeles, Portland, Seattle

He harnesses words to help sell electricity

E. L. Andrew

"Oh, St. Patrick was an engineer," lustily caroled the senior engineers at Wisconsin in the spring of '16. But to E. L. Andrew, St. Patrick has become the patron saint of merchandising and advertising as well.

Andrew liked engineering and had an excellent record in his work. But even in his high school days, he had been interested in writing. And that interest grew as he wrote for the annual, was successively editor and business manager of the Wisconsin Engineer, and was advertising manager of the Engineers' Famous Minstrel Show. He received his degree fully determined to harness words to help sell electricity.

At that time railroad advertising fascinated him. There was romance—and adventure—in the great tangle of tracks spread across the continent. So he applied and was accepted for a place in the Westinghouse Graduate Students' Course, hoping some day to do railroad advertising.

A month after he started the course he was made an instructor. For six months he had classes in the morning—then was free all afternoon to browse through the Westinghouse plant and learn those things that have made him valuable in the direction of Westinghouse advertising. But that's getting ahead of the story.

"What's the future with a large organization?" That is what college men want to know, first of all. The question is best answered by the accomplishments of others with similar training and like opportunities. This is one of a series of advertisements portraying the progress at Westinghouse of college graduates off the campus some five—eight—ten years.

Andrew left the educational department to be a requisition clerk handling requests for literature on Westinghouse irons, fans, toasters, percolators. Here he got his first glimpse of merchandising electrical appliances—an activity that was soon to rank with railroad electrification, marine engineering and the other important branches of the Westinghouse business. Andrew grew up with this development. He was one of the men who organized the merchandising section of the advertising department, which has remained under his charge since that time.

But his activities have been wider than this. Because of his understanding of both electricity and advertising, he was made assistant to the advertising manager, giving particular attention to national advertising. With the growth of the merchandising department, sales promotion also came under his charge.

Today he is manager of the sales promotion section of the merchandising sales department, head of the merchandising section of the advertising department, and assistant to the advertising manager.

To engineering graduates interested in technical writing and advertising, Westinghouse offers an opportunity for realizing ambitions to the full.

Westinghouse

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

CAMBRIDGE, MASS.

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY offers Courses, each of four years' duration, in Civil, Mechanical, Electrical and Aeronautical Engineering; Naval Architecture and Marine Engineering; Mining Engineering and Metallurgy and Geology; Architecture and Architectural Engineering; Chemistry, Chemical Engineering and Electrochemical Engineering; Biology and Public Health and Sanitary and Municipal Engineering; Mathematics, Physics, General Science and General Engineering; and in Engineering Administration. These Courses lead to the degree of Bachelor of Science.

To be admitted to the first year class applicants must have attained the age of seventeen years, and must satisfactorily fulfill entrance requirements in Algebra, Plane and Solid Geometry, Trigonometry, Physics, Chemistry, English, History and French or German and two units of elective subjects. Examinations are required in all subjects except Chemistry, History and the electives, the requirements for which are fulfilled by the presentation of satisfactory certificates. A division of these entrance subjects between different examination periods is permitted.

Entrance examinations are held at the Institute in September. In June applicants will be examined by the College Entrance Examination Board in Boston, New York, Philadelphia, Chicago and many other cities in America and Europe. A circular stating times and places is issued in advance by the College Board.

Graduates of colleges and scientific schools of collegiate grade, and in general all applicants presenting satisfactory certificates showing work done at another college corresponding to at least one year's work at the Institute, are admitted, without examination, to such advanced standing as is warranted by their previous training.

Graduate courses leading to the degrees of Master of Science, Master in Architecture, Doctor of Philosophy, Doctor of Science and Doctor of Public Health are also offered. Special Research Laboratories of Physical Chemistry, Organic Chemistry, Applied Chemistry and Science have been established.

Correspondence should be addressed to the Institute of Technology.

PUBLICATIONS

Catalogue; Bulletins of General Information, Summer Session, and Graduate Study and Research; and the Report of the President and the Treasurer.

Any of the above named publications will be mailed free on application.

For information, address

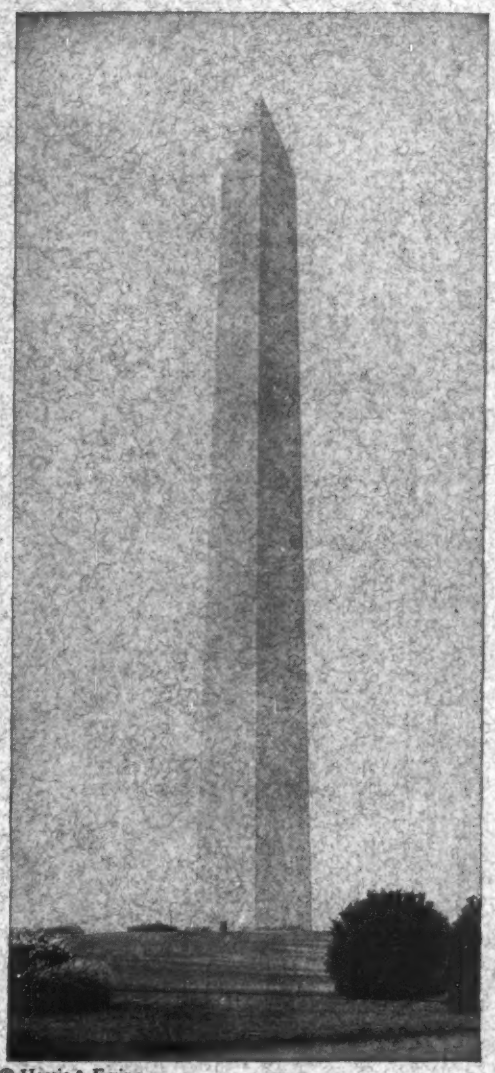
ADMISSIONS OFFICE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CAMBRIDGE A, MASS.

Uplift Applied To Monuments By Otis Elevators

THE Englishman confessed to his American friend whom he was conducting through the London Tower that never before had he visited that most historic building of his native city. It was always there; he could go any time. So he never did, until the insistent American prodded him into action.

Is it for a similar reason that so few college students in and around Boston visit the Bunker Hill Monument? Hardly: because they come from all parts of the country. Is it then another instance of indifference of college men? Not that either. College men in Washington generally ascend the Washington Monument.

No expert is needed to solve this puzzle. The ascent of the Bunker Hill Monument must be made on foot. It's a long, hard climb. But visitors to the Washington Monument are speedily and comfortably borne to the top in an Otis elevator.



© Harris & Ewing

AMERICAN HISTORY

1799—December—Congress passed Resolution for erection of marble monument in memory of George Washington.

1833—Corner Stone laid—

1839—Work stopped—

1880—Work resumed—

1884—100 oz, pure aluminum cap stone set.

1884-1926 Over 5,000,000 people ascended to top of Monument.

ELEVATOR CHRONOLOGY

1879—Otis Steam Elevator, installed for use in construction work.

1884—This elevator converted to passenger use. Round trip 17 minutes. Passengers carried to the top of the monument during the life of the elevator, 1,279,719.

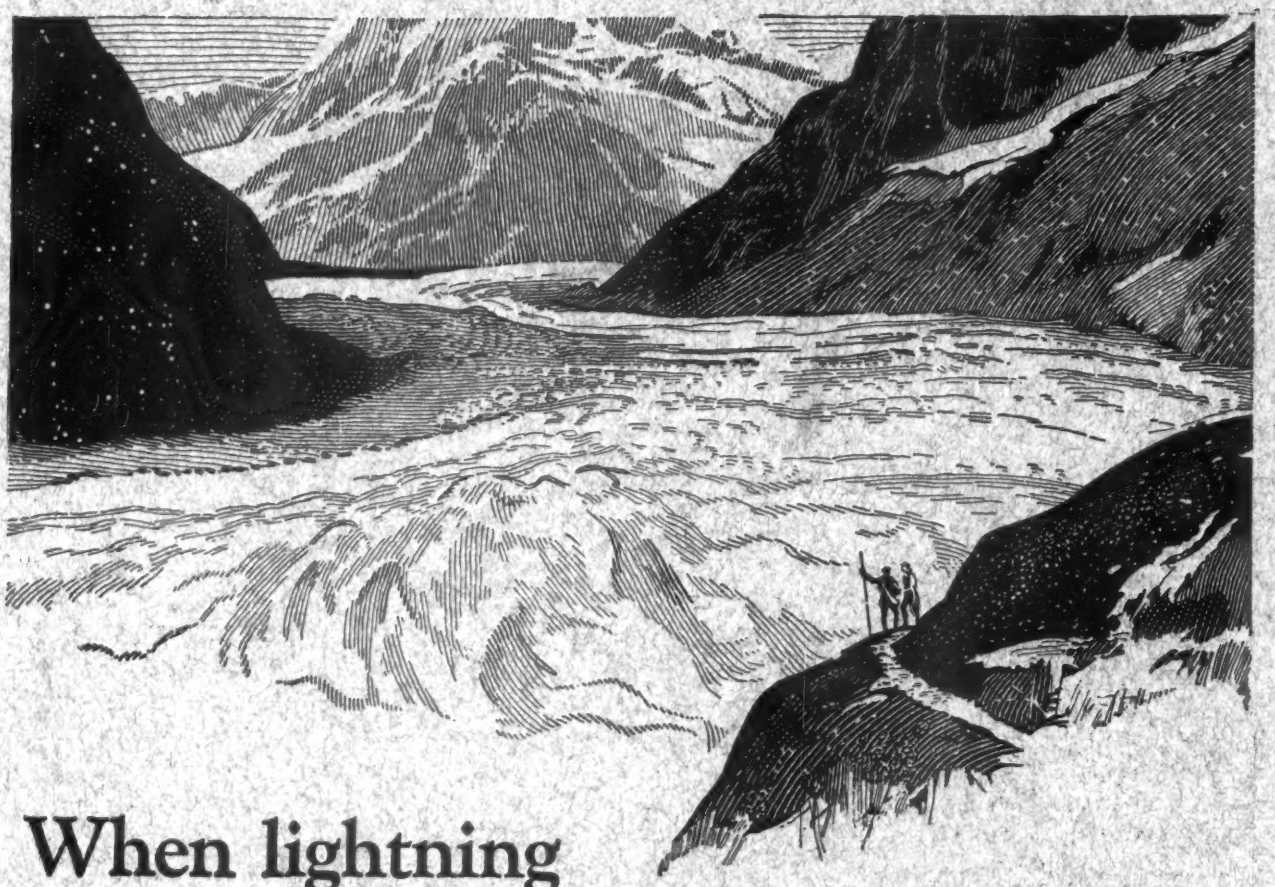
1901—Electric Elevator installed, having a round trip time of 10 minutes. Passengers carried up during its lifetime, 3,750,000.

1926—Otis Micro-Drive Gearless Traction Elevator installed, with a round trip time of 2 minutes. Will carry to the top of the monument an estimated number of 12,000,000 passengers in the same time as the life of its predecessor.

THE WORLD'S WORD FOR ELEVATOR SAFETY

OTIS ELEVATOR COMPANY

Offices in All Principal Cities of the World

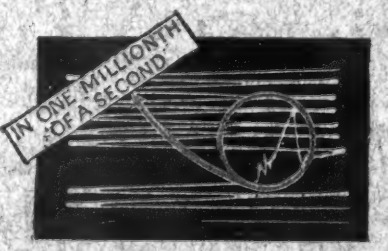


When lightning seems as slow as a glacier

It is easy to photograph a glacier because it moves but a few feet a year. But to photograph the effects of lightning on electric circuits—effects that come and go in millionths of a second—would seem impossible. Yet there is a man-made machine operated in the laboratories of the General Electric Company that does just this. It makes even lightning seem slow.

In the machine a swift-moving stream of electrons flashes across a photographic film. It dances out of its path when the freakish currents, caused by lightning, surge along the wires. There on the film is the footprint of lightning.

It has made possible a study of the working of a lightning arrester—the ingenious device that protects the costly equipment of the power house as well as the very lights in your home.



Above is one of the photographs—oscillograms they are called. The jagged curve is produced by the lightning. The surge traveled at the rate of thirty miles a second but it was recorded, and in the amazingly short time of one-millionth of a second.

Upon such scientific achievements as the cathode-ray oscillograph—lightning's camera—is the confidence in General Electric equipment founded. Many of these achievements are better known. The modern developments in x-ray, the service that has made MAZDA lamps a staple of commerce, the modern small motor that has taken drudgery out of household work—these are some of the milestones of progress.

610-19DH

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK